Volume 29 MARCH, 1923 Number 7

MACHINERY

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VOLUME 29

MACHINERY

NUMBER 7

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CONTENTS OF THIS NUMBER

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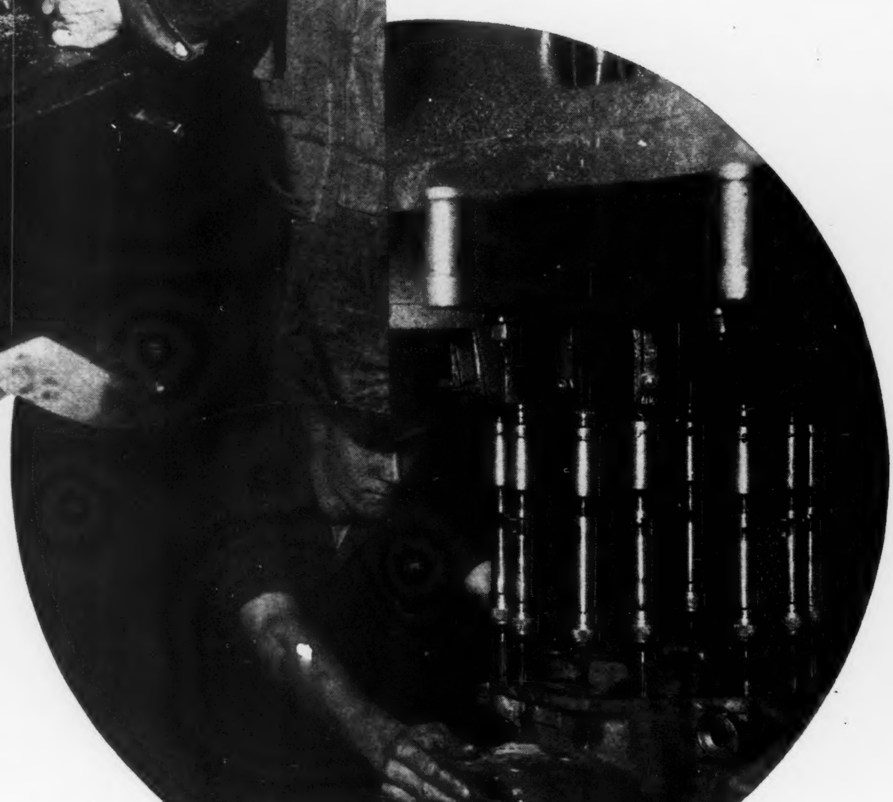
Stellite Milling Cutters, how they can be used to the best advantage, and how they ought to be designed so that they will give the best service, will be explained in the leading article in April MACHINERY.

The Small Tool

For months MACHINERY'S editors have been gathering and selecting and preparing articles for the Small Tool Number. The diversity of the tools that come under this classification and the wealth of material to be gone over have made this quite a task; but the result is commensurate with the effort. The April Small Tool Number will be one of the most interesting of the special numbers MACHINERY has put up for its readers. It will contain arti-



A feature of the Small Tool Number will be the special advertising section devoted to small tools, tool-holding and work-holding equipment of various kinds—those small but important accessories without which the mechanic is helpless and the machine useless.

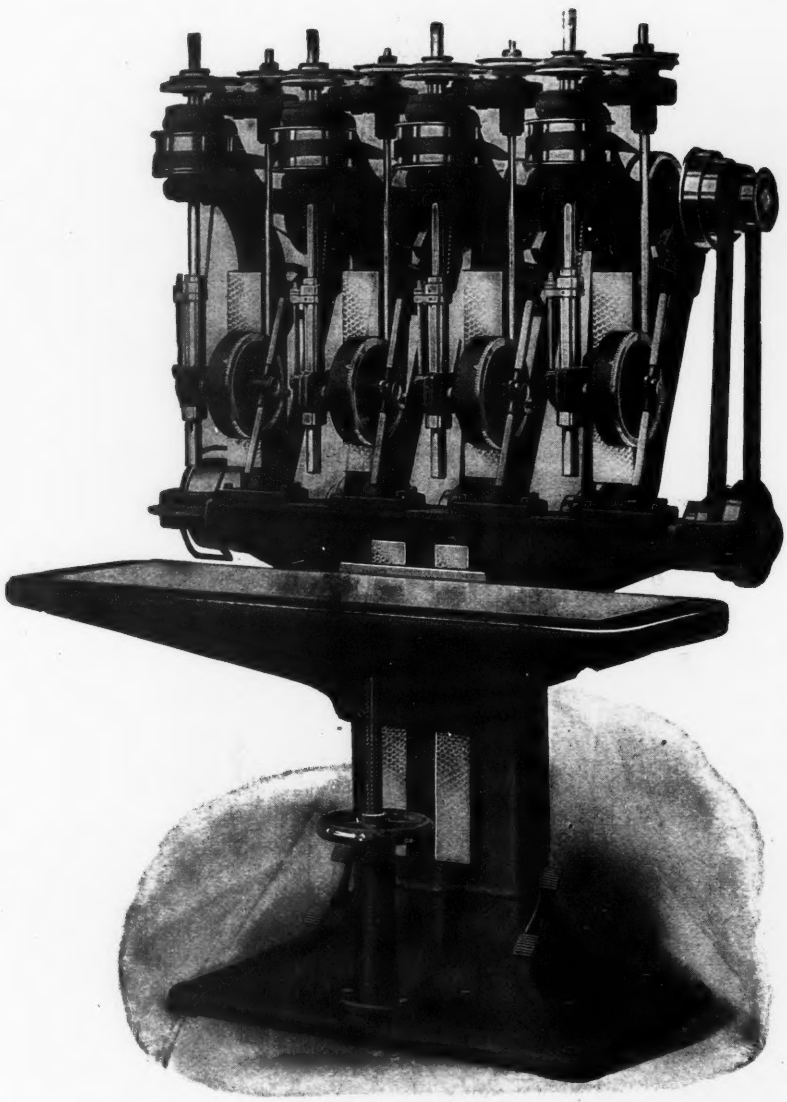
Reading Pages—Mechanical Practice

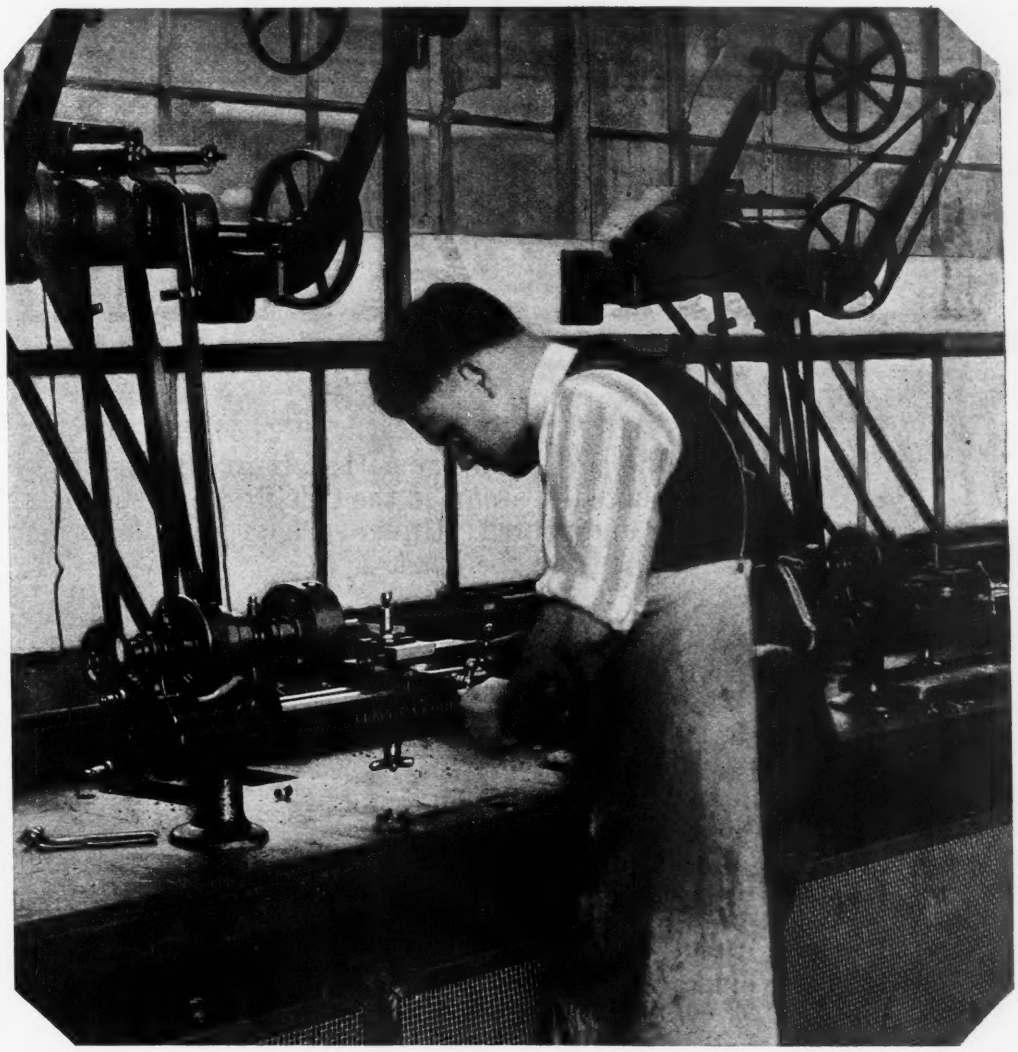
Number in April

cles on standardization with reference to small tools; the use of stellite in milling cutters; the difficulties incident to hardening high speed steel; how to check accuracy in hobs, hobbing machines and finished gears; how to sharpen square broaches; high speed drilling; tap drill sizes; the manufacture of adjustable reamers—and more of equal interest to small tool users. Not only will you want to read April MACHINERY; you will want to keep it for future reference.

The April Data Sheet gives dimensions of different types of cap screws and collar screws; there's a continuation of the most complete treatise on gear cutting practice ever published—and many other articles of general interest.

Advertising—Mechanical Products





Indispensable in the Modern Tool-room

—*a Producer on Small Precision Work*

PROPERLY equipped and understood the P. & W. Bench Lathe has a wide field of application on a great variety of work for which no other machine is suitable.

For tool, jig, fixture and gage manufacture the toolmaker finds a continuous use for it. Its convenience, accuracy and its adaptability for such work makes it a prime favorite with men who appreciate and can take advantage of these qualities.

The Bench Lathe is also rapidly growing in favor for light precision manufacturing. It is readily tooled for duplicate work. Its sensitiveness and convenience make it more productive on certain classes of small, fine work than the larger and more expensive machine tools.

All parts of the P. & W. Bench Lathe are made and checked to master gages insuring extreme accuracy and interchangeability. The various attachments—for threading, grinding, milling, filing, etc.—can be bought separately to meet your particular requirements. In this way you can choose equipment to suit your needs without having any parts or attachments that are superfluous.

Our new Catalogue No. 289 describes this machine fully. We'll be glad to send it to you.

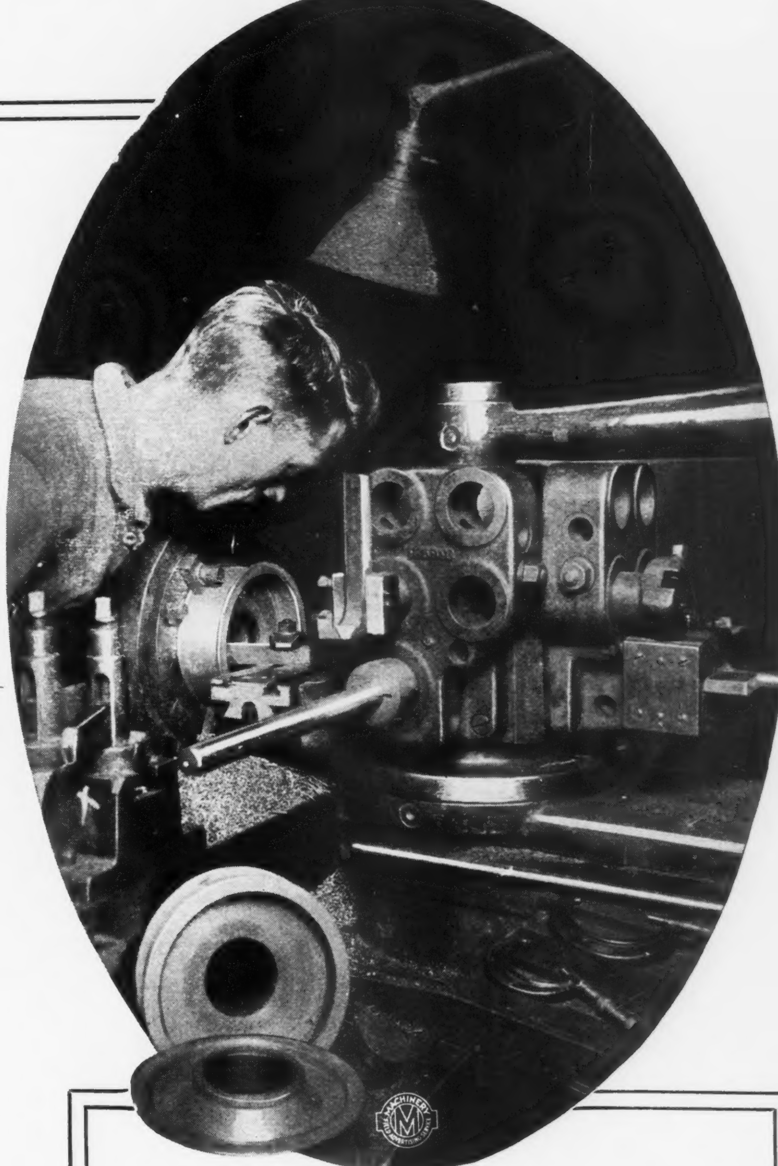
PRATT & WHITNEY COMPANY

WORKS: HARTFORD, CONN.

GENERAL OFFICE: 111 BROADWAY, NEW YORK CITY

P. & W. Bench Lathes

P & J Automatics



One Machine Builds Another

Accuracy is the first demand on a machine making interchangeable parts. Speed and economy must follow. All are combined in Potter & Johnston Automatics, selected by the Heald Machine Co., Worcester, Mass., to turn out large numbers of pulleys, gears, etc., for the well-known line of Heald Grinders.

The photo shows a cast-iron swivel-head pulley. The piece is strapped to a special fixture and the work of roughing and finishing inside diameter, bottom, flange face and rounding flange is accomplished in three turret positions and two passes of cross slide.

Though a good deal of stock is removed in this operation, the time for it is only 20 minutes. With P & J's one operator attends to a whole battery of lathes. Production costs are lowered and kept low. Output can be predicted with certainty. High quality work is maintained.

If you have some manufacturing operations that are costing too much write us. We'll be glad to tell what Potter & Johnston Automatics would do.

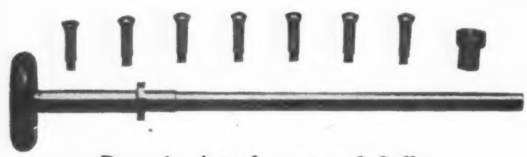
POTTER & JOHNSTON

PAWTUCKET, R. I., U. S. A.

DOMESTIC OFFICES: New York Office—Hudson Terminal Building, 50 Church St. Walter H. Foster, Manager. Detroit Office—The Potter & Johnston Agency Co., 535 Bates St. Chicago Office—3057 Eastwood Ave. Leslie J. Orr, Manager. Pacific Coast Office—Rosslyn Hotel, Los Angeles, Cal. Charles H. Shaw, Manager. FOREIGN REPRESENTATIVES: L. J. Colomb, 68 Avenue de la Grande Armee, Paris, France. Representative for France, Belgium, Switzerland, Spain and Portugal. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Ercole Vaghi, Corso Porta Nuova, 34 Milan, Italy. Rylander & Asplund, Stockholm, Sweden. Yamatake Company, No. 1 Yuracucho, Ichone, Kojimachiku, Tokyo, Japan.

LATHES **AMERICAN** PLANERS

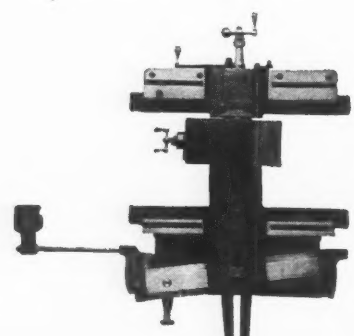
Why Not Make Your Present Equipment More Productive?



Draw-in Attachment and Collets

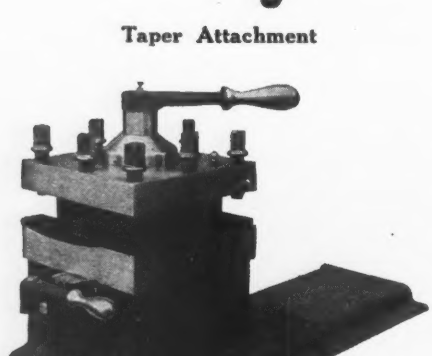
A Small Investment Often Saves 50 to 100% of Operating Costs

Don't blame a machine for retarding production unless you are sure you are using it to best possible advantage. The fault often lies in the method. Lathe work, for example, is sometimes hastily condemned as too slow for production simply because manufacturers fail to provide themselves with the necessary multiple tooling facilities by which one set-up can be made to answer for a whole cycle of operations.



Taper Attachment

"American" Lathes are unusually well provided in this respect; and, with the help of one of the turrets or other multiple tool holders, can handle much of the second operation work which comes through in small lots, or on which dimensions vary appreciably from time to time, at minimum cost—as shown by the examples on the opposite page.



Turret Tool Post

As manufacturers of a well-known line of Lathes, Planers, Shapers and Radials we have had first hand experience in the importance of a comparatively insignificant item of equipment. We'll be glad to tell you some of the things we've discovered which have helped us, as well as to describe the facilities we offer to broaden the serviceability of our own machines.

Relieving Attachment

THE AMERICAN TOOL

continuous service

Turret Lathe Takes its First Vacation

In 1891 this lathe, among the first of its kind, was sold to the Davis & Furber Machine Co., of North Andover, Mass.

That was thirty-one years ago. Davis & Furber advised us that it has been in constant service ever since it was installed. Now it is taking its first vacation in all those years. They have sent it back to us to be rejuvenated and made ready for more strenuous times to come, for it still has the capacity to give many more years of the same kind of service.

On the machine when it reached us was written in chalk the words "Good Bye, Good Luck, God Bless You." Who wrote this we do not know, nor whether it was entirely a matter of sentiment. At any rate there is a friendly flavor about it.

In allowing us to use this photograph for publicity, Davis & Furber write:

"It is the original turret lathe you put in our shop; it has been running steadily ever since; and since that time we have bought 36 more of your machines, putting some in almost every year."

In many respects the latest Hartness Flat Turret Lathe is similar to this first one built in '91. It has all those qualities which make for long and continuous service. Improvements, such as the cross sliding head, the double spindle, etc., that have been added to the original designs have greatly increased the productive capacity, the accuracy and the tool economy of the "Hartness" until now we believe—and we have many endorsements to strengthen us in the belief—that it is the most adaptable and economical machine of its kind today.

Let us tell you all about the special advantages that make the Hartness Flat Turret Lathe best for your work. Write today for complete details.

JONES & LAMSON MACHINE COMPANY

Springfield, Vermont, U.S.A.

Branch Office:
San Francisco, California
503 Market Street

AGENTS:

Japan, Korea, Manchuria, Formosa
Mitsui Co., Ltd., Tokio

France, Spain and Belgium—F. Auberty & Co.
182 Rue Lafayette, Paris

Australasia—McPherson, Pty., Ltd.,
554 Collins St., Melbourne

Branch Office:
London, England
9-10 Water Lane, Queen Victoria St.

AGENTS:

Holland—Spliethoff Beeuwkes & Co.
Leuvehaven, Wz., 159 Rotterdam

Sweden—A. Bol. Oscar Lindbom
Stockholm—Post Box 420

"Going Great Guns"

This Geometric Adjustable Non-Collapsing Tap

is tapping Union Nuts with a 1.6″—12 Thread, at the Sprague Meter Company, Bridgeport, Conn., and is "Going Great Guns," it is said. 175 Pieces Tapped Per Hour.

This Geometric Solid Adjustable Tap is producing for the Sprague Meter Company many times the threaded pieces ever before obtained from a solid tap. The many benefits of the Tap combine to make this job the satisfactory operation that it is.

The Micrometer Adjustment compensates for wear and regrindings of the chasers.

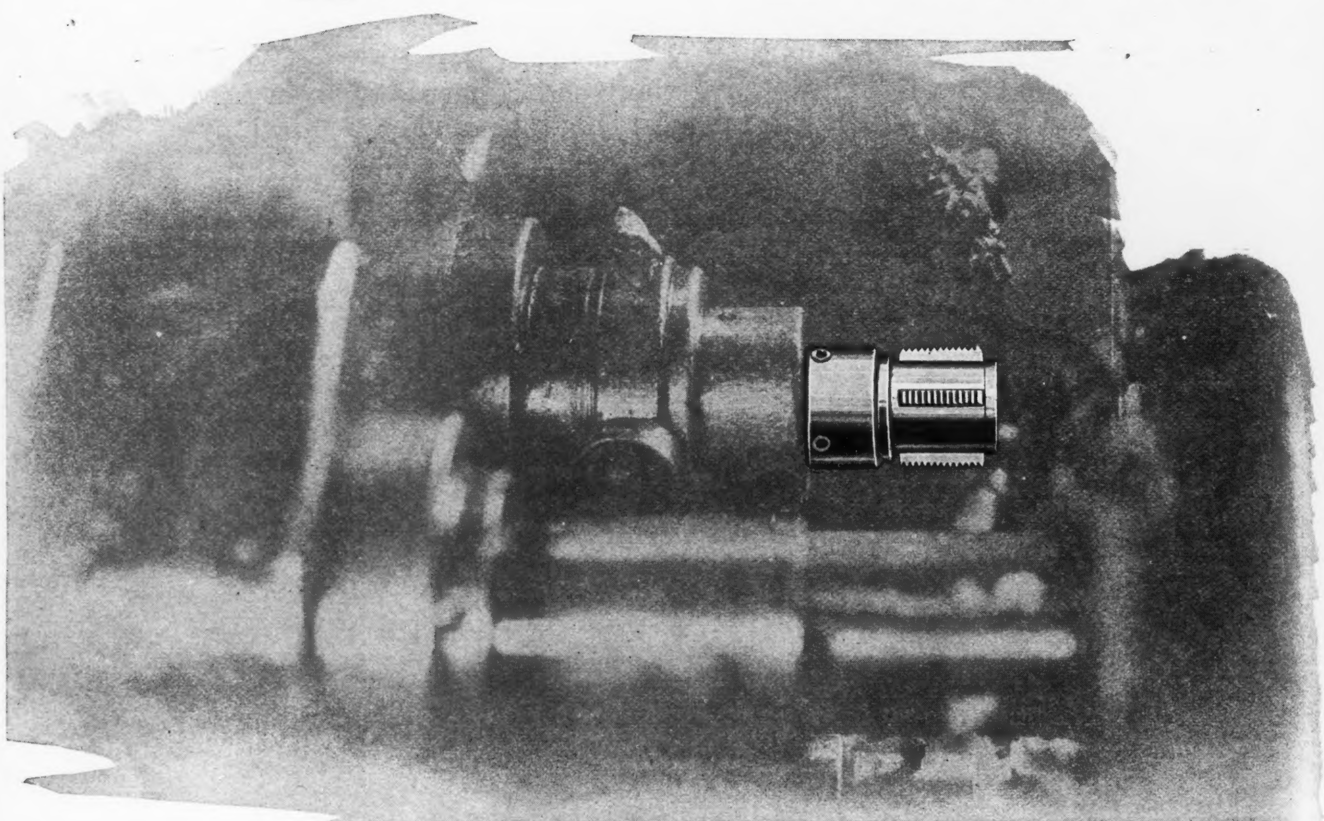
To renew the Tap, all that is necessary is the inserting of new chasers.

The adjustments are at the side, making it possible to adjust without taking the Tap out of the holder or disturbing the set-up in any way.

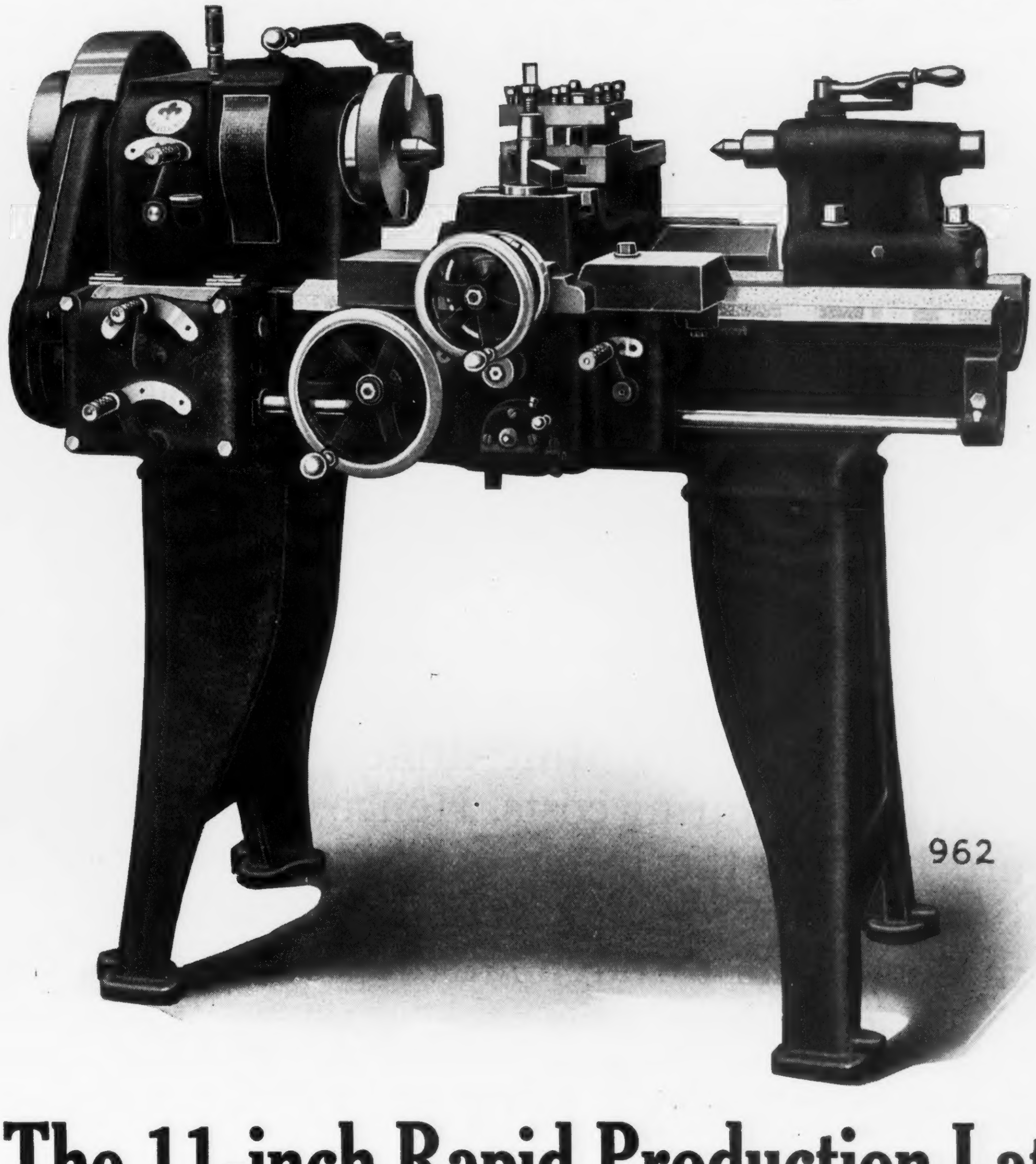
Chasers are renewed and inserted by simply taking off the front cap, and, again, without removing the Tap from the machine spindle.

This Geometric Tap may be used either as a Hand Tap or as a Machine Tap

THE GEOMETRIC TOOL CO.
NEW HAVEN, CONN., U. S. A.



A Sturdy, High Grade, Small Lathe for Many Small Manufacturing Jobs



The 11-inch Rapid Production Lathe

Embodies all of the production features that have made LeBlond Lathes standard in the principal manufacturing shops of the country.

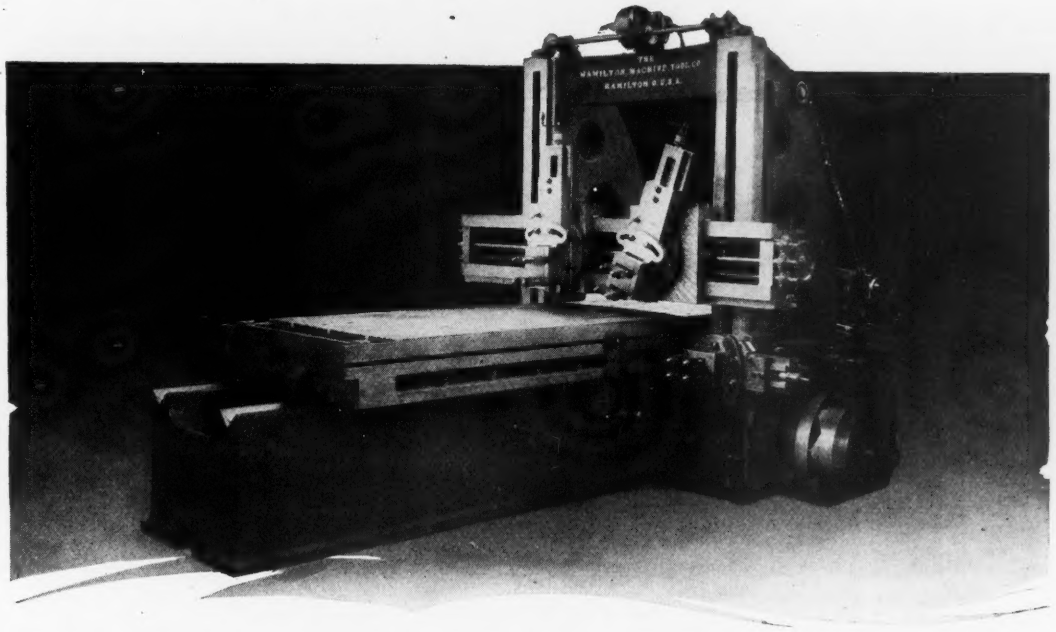
The automatic back facing attachment provides for turning and facing simultaneously with multiple or gang tools.

Descriptive literature now ready

The R.K. Le Blond Machine Tool Co.

Cincinnati. Ohio.

SKF



With Thrust Ball Bearings on Elevating Screws Planer Cross Rails Are Easily Adjusted

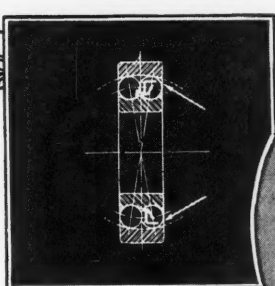
THE oil film, upon which ordinary thrust bearings on the elevating screws for the cross rails of planers depend for their proper functioning, soon breaks down under the heavy weight of the cross rails which they must support continuously. This leaves metal to metal contact which makes it difficult to elevate or lower the rails and which quickly destroys the bearings.

In this heavy-duty planer these troubles are avoided by using SKF marked thrust ball bearings on the elevating screws. The load is carried on polished steel balls which roll practically frictionless and with no appreciable wear between races of hard polished steel. Lubricant is needed mainly to prevent the highly polished surfaces from rusting and is effectively retained in the sealed housings.

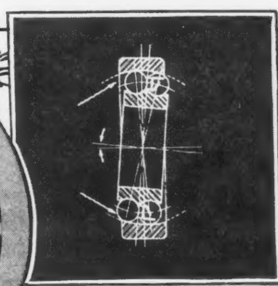
Bearing problems on machine tools of all kinds are constantly being solved by our engineers. May they co-operate in solving yours?

THE SKAYEF BALL BEARING COMPANY
Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

877



Normal View

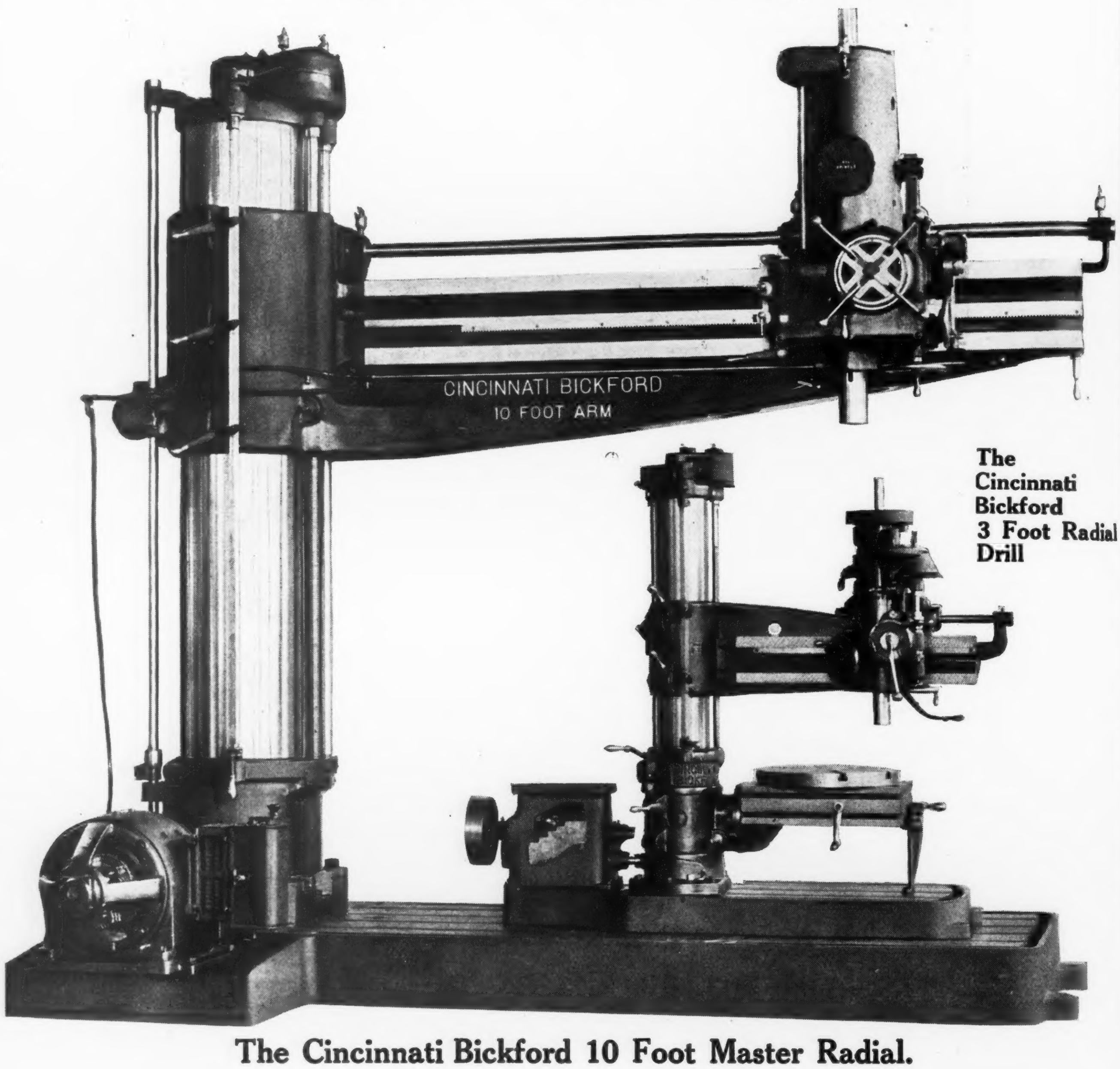


Deflected View

BALL BEARINGS
The Highest Expression of the Bearing Principle

CINCINNATI BICK

Efficiency Plus—The Climax of 49 Years of Development



The Cincinnati Bickford 3 Foot Radial Drill

The Cincinnati Bickford 10 Foot Master Radial.

The Cincinnati Bick

FOUNDED 1874

OAKLEY,

AGENTS: **Alabama:** Dewstoe Machine Tool Co., Birmingham. **California:** Harron, Rickard & McCone, Los Angeles and San Francisco. **Connecticut:** Henry Prentiss & Co., Inc., Hartford. **Georgia:** Seeger Machine Tool Co., Atlanta. **Illinois:** Marshall & Huschart Machinery Co., Chicago. **Indiana:** Marshall & Huschart Machinery Co. of Indiana, Indianapolis. **Louisiana:** C. T. Patterson Co., Ltd., New Orleans. **Maryland:** Kemp Machinery Co., Baltimore. **Massachusetts:** Henry Prentiss & Co., Inc., Boston. **Michigan:** Motch & Merryweather Machinery Co., Detroit. **Minnesota:** Robinson, Cary & Sands Co., Duluth and St.

FORD RADIALS

Of Interest to Every Man Responsible for Production

"The real value of any service lies in the ability to do a thing completely." Convenience, durability, power, versatility—there are drilling machines in almost every line which excel in one or another of these essential qualities; but where will you find a machine in which all four are developed as completely as in the Cincinnati Bickford Master Radial?

Driving a 3″ drill 2.53″ per minute through 55 point steel at 101 revs. and .025″ feed is no tax on this machine. Its arm is capable of resisting more than a 10,200 pound thrust. Outer column is 22″ diameter, inner column reinforced its full length and provided with radial and thrust bearings. Base is 12″ deep and well ribbed; gearing of nickel steel, *carbonized and hardened*, and ball or bronze bearings are used throughout. Speeds from 22.8 to 510 per minute are readily available and feeds of 8, 10, 12, 14, 16, 20, 25, 30, 35 and 40 thousandths per revolution. Base to cap-plate this machine embodies the highest attainable degree of efficiency.

We manufacture also the well-known line of Cincinnati Upright Drilling Machines, the largest of its kind in the world. A record of more than 25,000 Upright and Radial Drilling Machines in daily operation and giving complete satisfaction is good and sufficient endorsement of the quality and efficiency of these Cincinnati Bickford products. Bulletins on request.

---

ford Tool Company

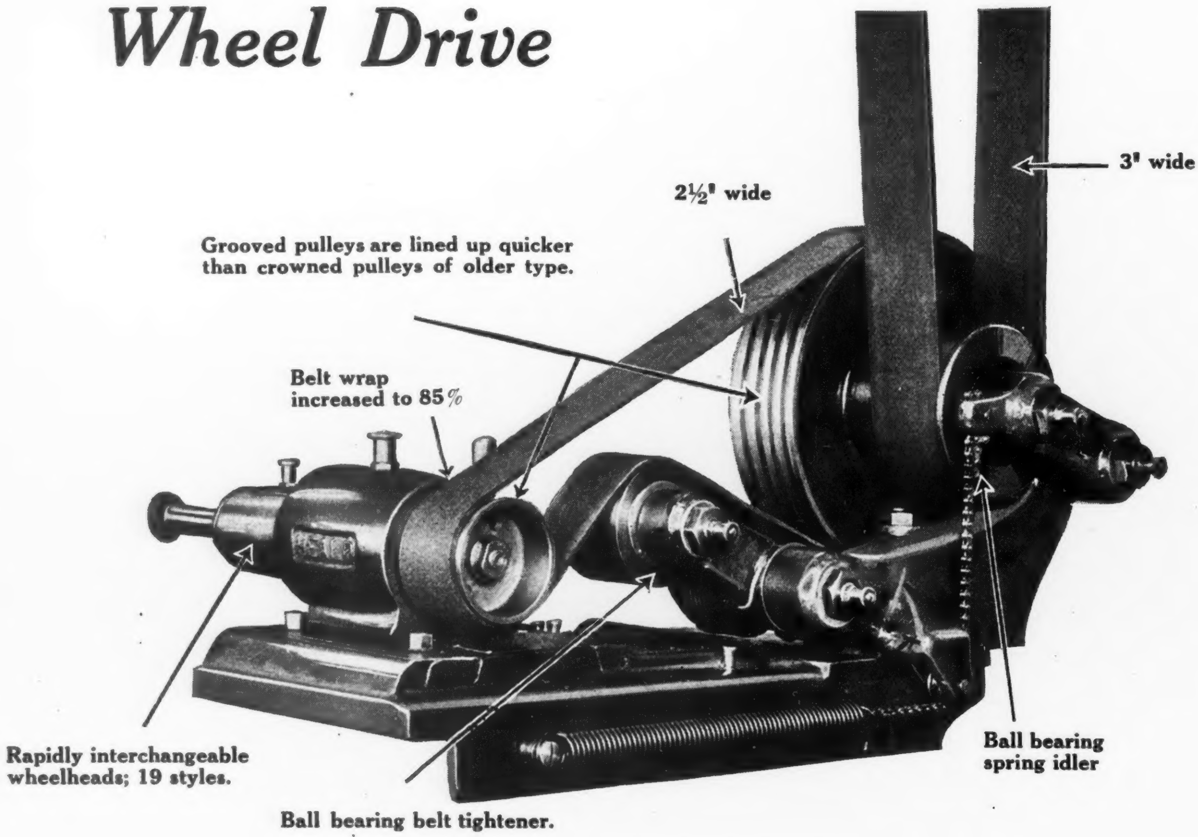
CINCINNATI, OHIO

FOUNDED 1874

Paul. **Missouri:** Elliott & Stephens Machinery Co., St. Louis. **New York:** Henry Prentiss & Co., Inc., Buffalo, New York City, Syracuse and Rochester. **Ohio:** Motch & Merryweather Machinery Co., Cincinnati, Cleveland and Columbus. **Ontario:** H. W. Petrie, Ltd., Hamilton and Toronto. **Oregon:** Zimmerman-Wells-Brown Co., Portland. **Pennsylvania:** W. E. Shipley Machinery Co., Philadelphia; Brown & Zortman Machinery Co., Pittsburgh. **Quebec:** Williams & Wilson, Ltd., Montreal. **Tennessee:** Hamilton Machinery Co., Chattanooga. **Texas:** Gulf Machinery & Ship Supply Co., Galveston. **Utah:** The Salt Lake Hardware Co., Salt Lake City. **Washington:** Hallidie Machinery Co., Seattle; General Machinery Co., Spokane.

One of the Units that make

1923
Wheel Drive



Consider these Points

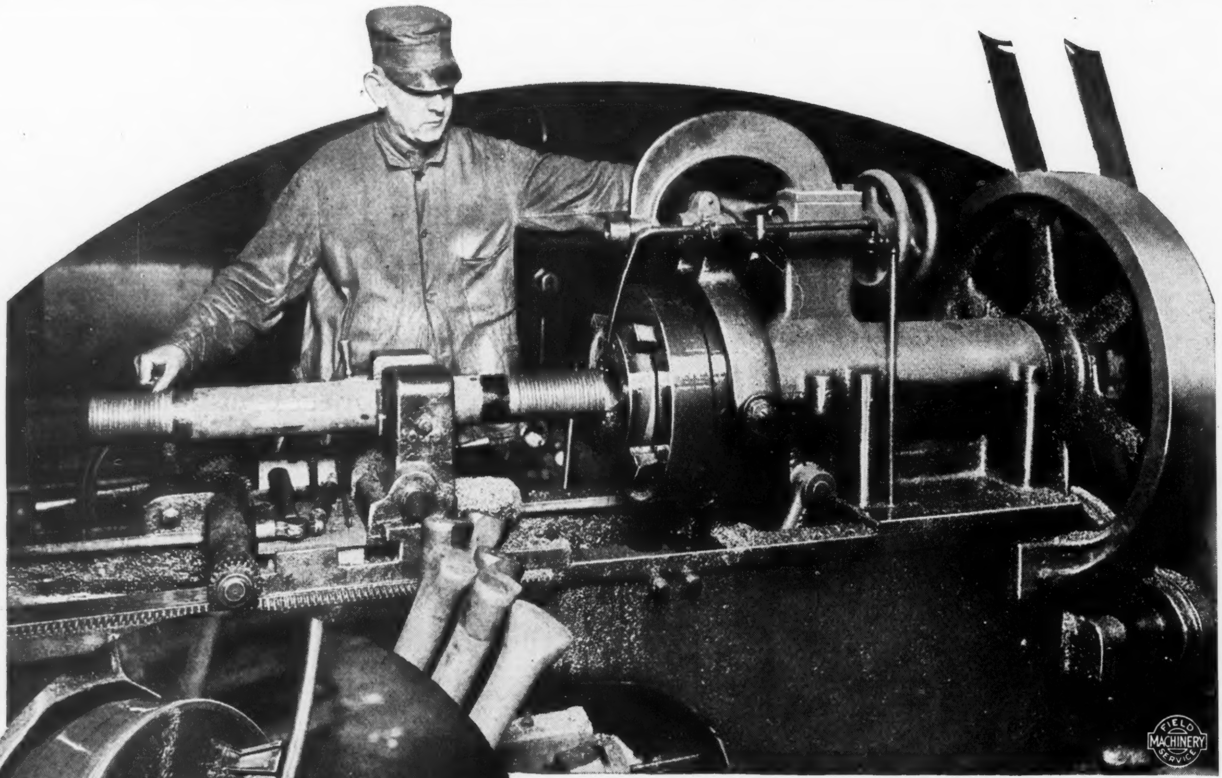
for accurate Quantity Production

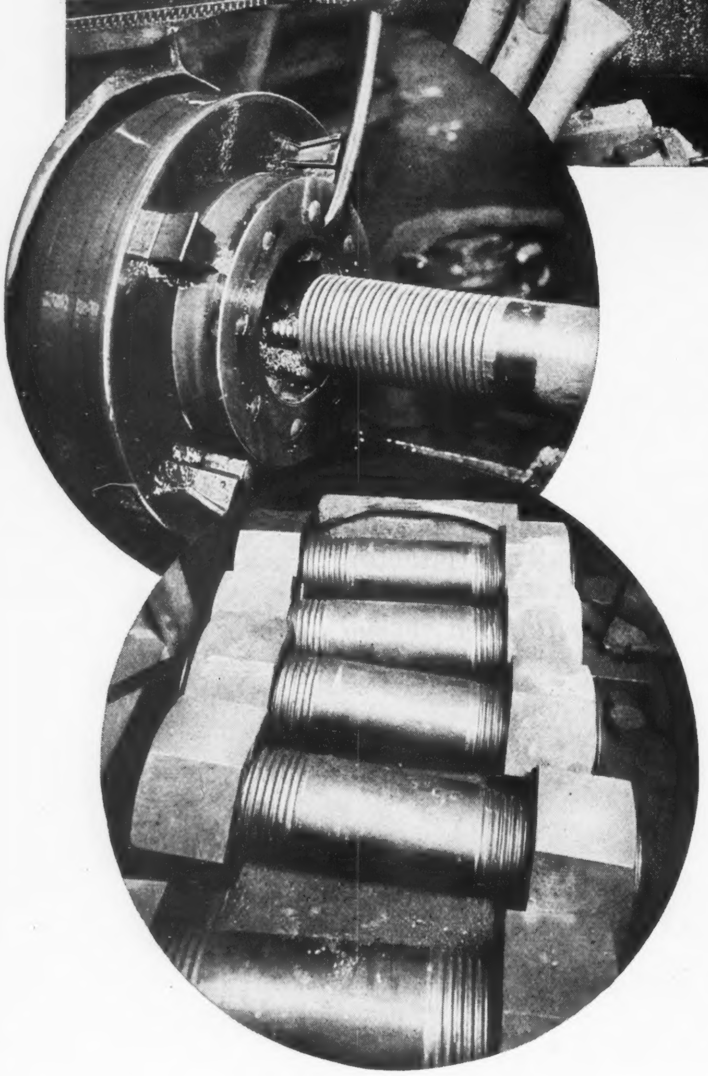
1. UNUSUALLY POWERFUL
   (Has wide belts and 85% pulley wrap.)
2. CONSTANT SPEED UNDER HEAVY LOAD
   (A ball bearing spring idler insures this.)
3. SMOOTH AND EVEN PULL
   (Endless leather belt produces this.)
4. QUICKLY INTERCHANGEABLE WHEEL HEADS
   (Any one of 19 different sizes can be instantly slid in place.)

Grind with a HEALD and be sure

Acme Threading Machines

A complete description is given in our latest catalog





More facts on request. Send for catalog *now*. It will pay you to do so.

Discriminating Users Endorse Them

Threading bolts with accuracy, speed and profit, finishing each bolt well enough to catch the eye and admiration of discriminating men who by long experience recognize quality workmanship on sight—that's Acme Threading Machine performance.

The picture shows one of two Acme Bolt Cutting and Threading Machines in the Allentown plant of the Traylor Engineering & Manufacturing Co., after six years of steady service, and they are as good today as when brand new.

Acme Die Heads are simple, durable and economical. All wearing parts of tool steel, hardened and ground.

The Acme Machinery Company

CLEVELAND OHIO, U. S. A.

Foreign Agents: Burton, Griffiths & Co., Ltd. London. Glaenzer & Perreaud, Paris, France

AMERICAN SWISS FILES

Files of Precision Toolmakers' Files

It's when finishing narrow spaces and sharp internal corners that the toolmaker most fully appreciates the difference between *American Swiss* and the ordinary commercial file.

The teeth of *American Swiss Files* are cut uniformly deep and true *clear out to the point,* on both edges.

Pippin files, for example, such as the file-maker here shown is making, are machine cut on the flat sides, but along the edges of the file, the teeth are cut by hand in the soft surface of the annealed file-stock.

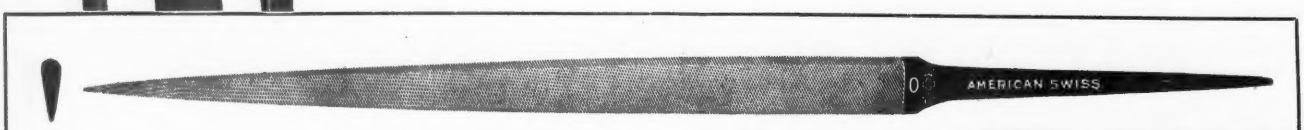
A small matter perhaps, but one that is often and favorably commented on by our customers.

Skillful finishing and exact uniformity in tempering are the chief reasons America's most particular toolmakers specify *"American Swiss."*

American Swiss File & Tool Company

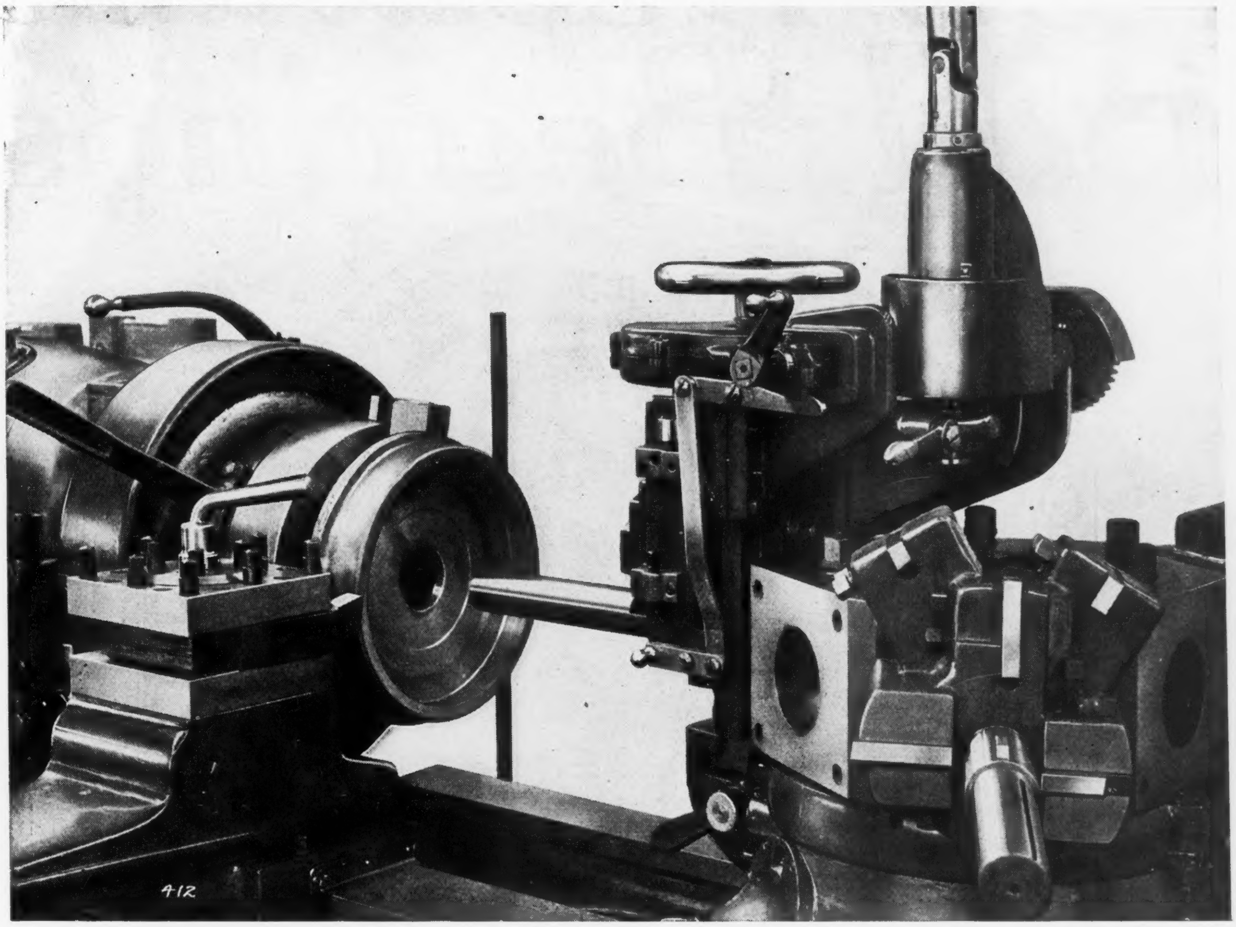
410-416 Trumbull Street, Elizabeth, N. J.

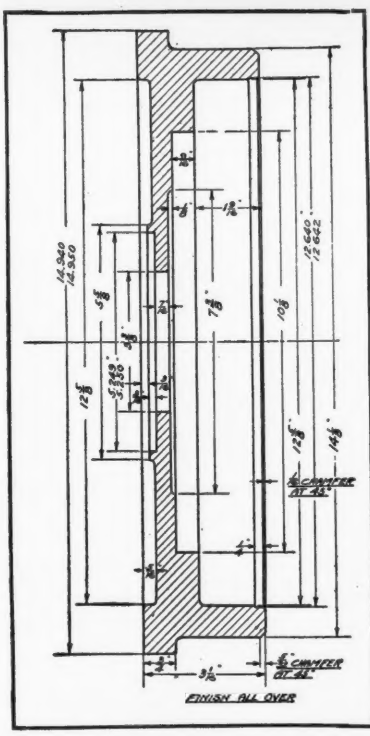
LIST OF DISTRIBUTORS: Anchor Tool & Supply Co., New York City; Aetna Machinery Co., Philadelphia, Pa.; Boyer-Campbell Co., Detroit, Mich.; Chandler & Farquhar Co., Boston, Mass.; Coghlin-Kirkby Machinery & Supply Co., Toledo, Ohio; Ducommun Hardware Co., Los Angeles, Cal.; Peter A. Frasse & Co., Inc., New York City; Hamilton Hardware Corp., Waterbury, Conn.; M. D. Larkin Supply Co., Dayton, Ohio; Ludlow & Squier, Newark, N. J.; C. S. Mersick & Co., New Haven, Conn.; Machinists Supply Co., Chicago, Ill.; Machinists Supply Co., Pittsburgh, Pa.; C. W. Marwedel & Co., San Francisco, Cal.; Sidney B. Robey Co., Rochester, N. Y.; Charles A. Strelinger Co., Detroit, Mich.; Louis F. Seltenreich, Buffalo, N. Y.; Syracuse Supply Co., Syracuse, N. Y.; Tracy, Robinson & Williams, Hartford, Conn.; White Tool & Supply Co., Cleveland, O.



FILES ONLY THE BEST ARE GOOD ENOUGH TOOLS

LIBBY LATHES





"Libby-time"

Look at the dimensions on the sketch, the number of cuts taken, and estimate the time required to do the work in your shop. How does it compare with Libby-time at the Studebaker plant—12 minutes, floor to floor?

Your exact needs may be different, but if you tell us what you make, the time it takes, or just send blueprints, we'll submit a Libby-time schedule which may surprise you. Ask for it. No obligation.

International Machine Tool Company
INDIANAPOLIS, IND.

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore. Md.; Blackman-Hill-McKee Machinery Co., St. Louis, Mo.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore., Seattle, Wash.; E. L. Essley Machinery Co., Chicago, Ill., Moline, Ill., Milwaukee, Wis.; Hill, Clarke & Co., Boston, Mass.; Northern Machinery Co., Minneapolis, Minn.; Seifreat-Woodruff Co., Cincinnati, Ohio, Dayton, Ohio; Strong, Carlisle & Hammond Co., Detroit, Mich., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York City, N. Y., New Haven, Conn., Philadelphia, Pa. FOREIGN AGENTS: Andersen, Meyer & Co., Shanghai, China; Coats Machine Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque Todd & Co., Belgium; Iznosskoff & Co., Petrograd, Russia, Moscow, Ekaterinburg, Russia; V. Lowener, Copenhagen, Denmark, Christiania, Norway, Stockholm, Sweden; Victor B. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France; Mitsui & Co., Japan.

New Departure Ball Bearings

The Secret of Quiet Gears

"Gears do not require adjustment to compensate for wear, so a correct position once attained should never be altered," says a leading authority on gears.

Therefore, a type of bearing which must be adjusted for wear naturally disturbs the original setting of the mating gears every time the bearing is "taken up."

As a result, the gear must "wear in" in a new position and noise develops.

New Departure ball bearings do not wear—are, therefore, made non-adjustable, and are ideal for supporting and locating all types of gears.

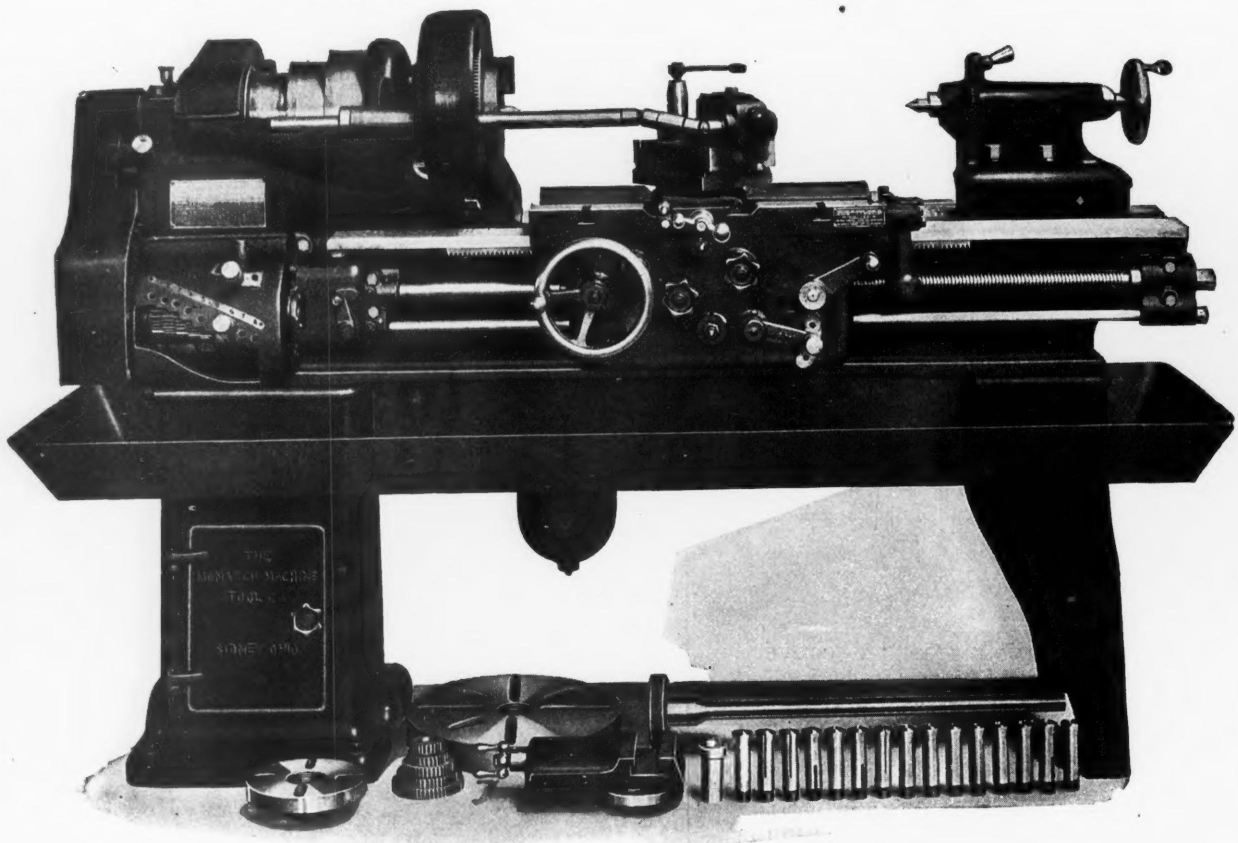
Engineering Data on Request

The New Departure Manufacturing Co.

Detroit ***Bristol, Conn.*** **Chicago**

Monarch Tool-room Lathes

16"x6' Monarch Tool-room Lathe with full equipment, including *UNIVERSAL Relieving Attachment, Taper Attachment, Draw-in Attachment, Chasing Dial* and *Chasing Stop.*



Many other sizes of Monarch lathes can be furnished with complete tool-room equipment. Complete range of sizes 9-inch to 30-inch swing.

Special features of Monarch tool-room lathes include the following:

Full double plate apron with all drop-forged steel gears and central oiling system for back plate.

Efficient full Universal Relieving Attachment which is quickly attached and removed from the lathe.

Has all the features required for the rapid accurate making of tools and gauges.

Is constructed of the very finest materials and in sufficient quantity to justify the most modern methods of duplicate quantity production in their manufacture.

Monarch lathes are *manufactured* in quantity, not *built* singly or in small lots. As a consequence Monarch lathes are always attractively priced. Inspection records which are guarantees of accuracy accompany each lathe showing the accuracy of the lead screw for chasing and of the alignment of the lathe for accuracy in turning, facing and boring.

Few lathes equal and none rival the Monarch lathe for accuracy and efficiency.

THE MONARCH MACHINE TOOL CO.

209 Oak Street, Sidney, Ohio, U. S. A.

AGENTS:

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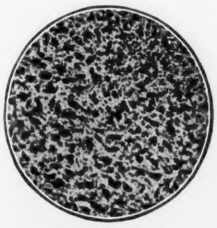
Absolute UNIFORMITY
Proved by the Microscope


Remelt No. 1

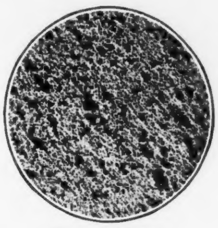
REMELT No. 1
Magnified 14 diameters

This area on the ingot was actually about 1/16 of an inch in diameter. The light areas show the matrix of copper holding the black spots of lead. Note how even the distribution of metal is.


Remelt No. 2

REMELT No. 2
Magnified 14 diameters

Notice again the even distribution of the black spots [lead] throughout the area. There is no evidence whatever of any tendency toward segregation.


Remelt No. 3

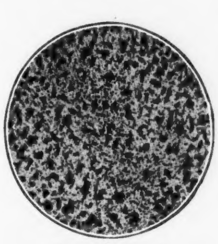
REMELT No. 3
Magnified 14 diameters

Each of these photographs was made of metal in the same relative place in each ingot, so that the comparison is direct. Note that between the principal spots of lead there are smaller particles. With this distribution of lead throughout the metal in a space only 1/16" square, there is abundant cushion for the shaft.


Remelt No. 4

REMELT No. 4
Magnified 14 diameters

This is a most remarkable demonstration for if ever segregation were to occur, it would have started before the fourth remelt. The copper holds the lead in thorough suspension—a complete mixture of two unlike metals which, combined, make the most perfect bearing metal known.


Remelt No. 5

REMELT No. 5
Magnified 14 diameters

Compare this photograph with No. 1 above. If anything, the distribution of lead throughout the copper is more complete than when remelting began. Because these remeltings were made under conditions of ordinary foundry practice, the results can be duplicated anywhere at any time.

Stewart

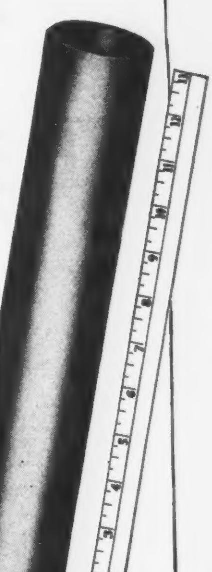
The most remarkable Copper-Lead bearing metal in the history of the industry

The Story of the Test—Several bars of Stewart "D" Bearing Metal (50 Brinell test) were taken at random from stock and handed to a melter to remelt and pour into ingots. One ingot was marked "D1," the balance were again melted and recast. One was marked "D2" and the balance recast, and so on until five remeltings were made. The five ingots, D1, D2, D3, D4 and D5 were then turned over to Prof. A. H. Carpenter of a prominent technical college for microphotographs to determine whether segregation of lead and copper had taken place.

THE five photographs at the left tell a most remarkable story. Through five *remeltings*, Stewart Bearing Metal taken from stock did not break down or segregate, and its uniformity was proven. An excerpt from Prof. Carpenter's report reads:

"I have made numerous microphotographs of samples for you and have found them 'uniform' in the sense that the copper and lead are evenly distributed. In this series, made to determine whether the metals would separate after a number of remeltings, I can see no difference in the distribution of metal in the first, last or in any of the series."

Tests show that above 600° this metal sweats a little lead, lubricating itself. Even at 1000° it does not score shafts. Though lubrication fails, it will not melt up to 1700°.



Big Savings the Great Result

Stewart Bearing Metal can be bought confidently. It cuts down operating costs amazingly. Our 13-inch stock bars and bushings, finished all over, give 12 full inches of bearings with ample room for chucking and tool clearance and practically no waste. We can show outright savings of 47.4%.

Stewart Bearing Metal is made in four grades: "B" 25 Brinell; "C" 40 Brinell; "D" 50 Brinell; "E" 80 Brinell [a special metal for heavy service]. Made in bars and bushings in 13" lengths, FINISHED ALL OVER, 258 sizes in stock. Bars and bushings over 4½" diameter on order. Finished bars or bushings can be made to dimensions as specified.

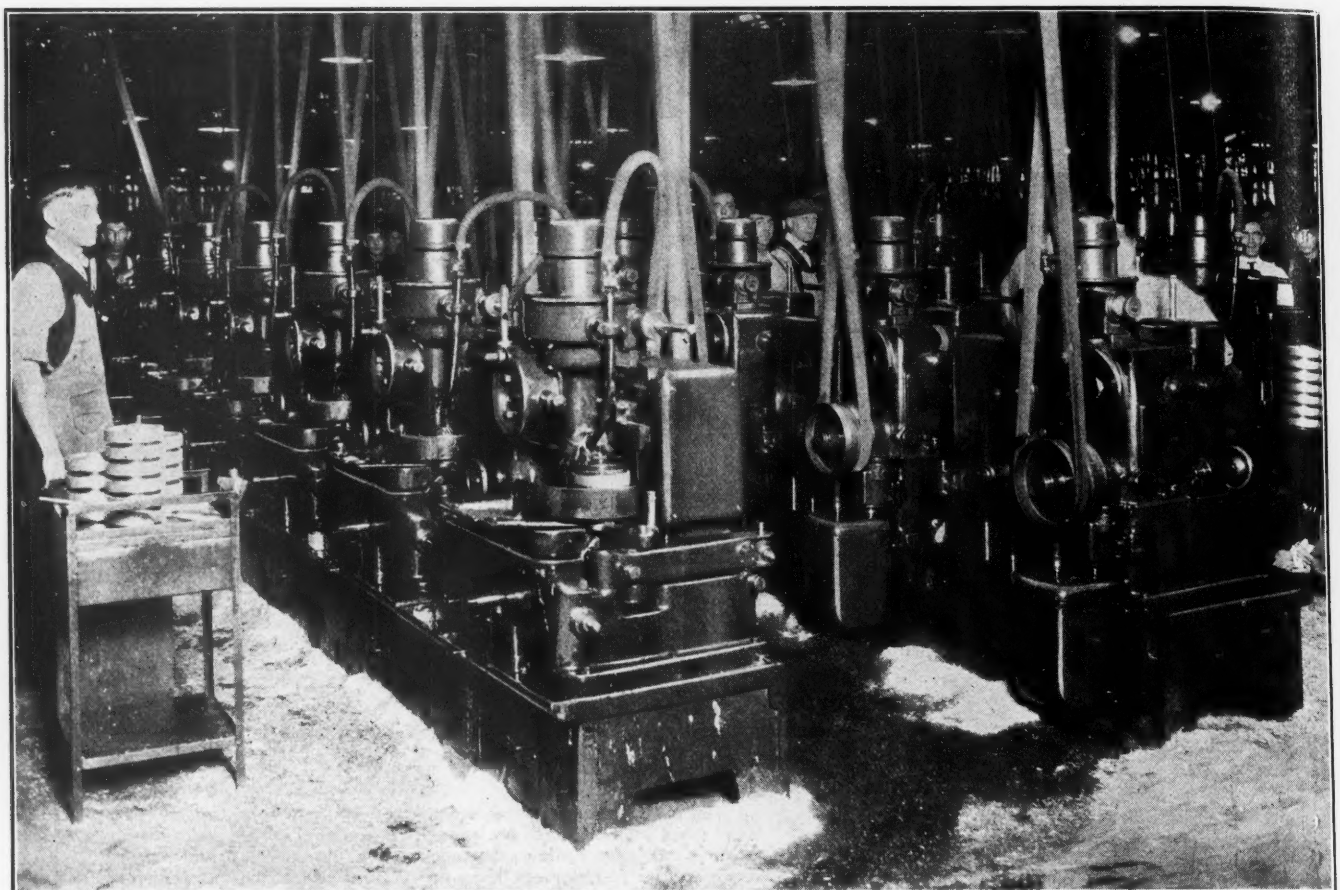
A few territories remain to be allotted to distributors. Jobbers find our 13" bar a wonderful seller because of its obvious economies

Stewart Manufacturing Corporation
4503-83 Fullerton Avenue Chicago, Illinois

Or communicate with our nearest factory representative:

L. RUPRECHT 30 Church Street New York, N. Y.	A. C. OLFS 7321 Woodward Ave. Detroit, Mich.	C. W. ROOT 57 Erie Street Milwaukee, Wis.
J. FRANK LANING & CO. 327 First Avenue Pittsburgh, Pa.	E. P. GRISMER Caxton Bldg., 800 Huron Rd. Cleveland, Ohio	

Stewart Bearing Metal
The Perfect Metal for Bearings



Battery of High-speed Gear Shapers in operation on Helical Timer Gears in one of the large Automobile Plants.

Repeat Orders Furnish Convincing Proof

that the new High-speed Gear Shaper is successfully meeting production requirements. Users of this machine have, when production requirements demanded additional equipment, purchased more Gear Shapers.

In one particular instance, two machines were installed which, inside of six months, were followed by two more; and in less than two years, over twenty of these machines have been installed.

The new High-speed Gear Shaper has in all cases made good on work for which it is adapted.

It is a profitable investment. Don't overlook it if you have gears to cut

Descriptive literature upon request

The Fellows Gear Shaper Company

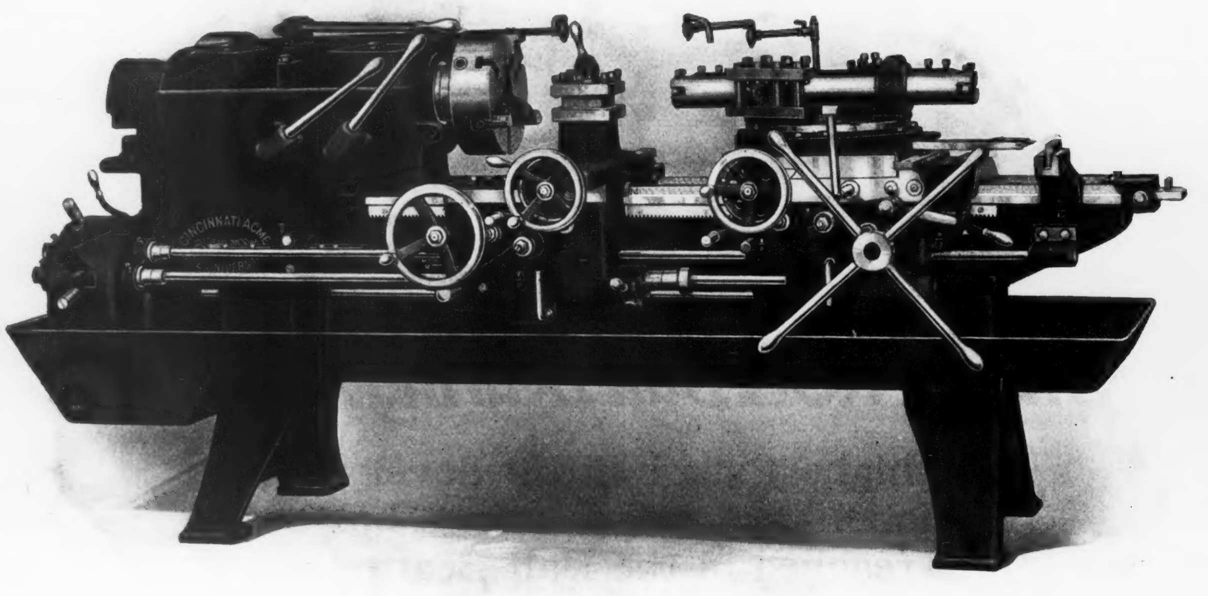
Springfield, Vermont, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India) Ltd., Head Office, Calcutta, India; J. Kamenicek & Co., Prague, Czecho-Slovakia; Bohm & Bormann, Berlin, Germany; Werkzeug-Und Maschinenfabriks—A.-G., Wemag, Wien. Austria.

PACIFIC COAST REPRESENTATIVES: Eccles & Smith Company, Portland, Oregon; Seattle, Washington; San Francisco and Los Angeles, Calif.

A Real Machine for Real Production

CINCINNATI ACME No. 2 Universal Flat Turret Lathe



No. 2 Cincinnati Acme Universal with Chucking Equipment.

These Features Will Appeal To You

All geared head, twelve speeds.

Speed changes without stopping machine.

Power cross travel to both turret and side carriage.

Power feed cross and longitudinal to both turret and side carriage (both independent).

Rapid traverse to turret.

Positive automatic disengagement of power feeds.

All levers convenient to operator.

Simple tooling with use of flat turret.

Safety features for operator.

Equally efficient on bar or chuck work.

Many other features.

Let us send you Bulletins describing this machine in detail, also our other sizes of turret machinery. It will pay you to get our proposal.

The Acme Machine Tool Co.

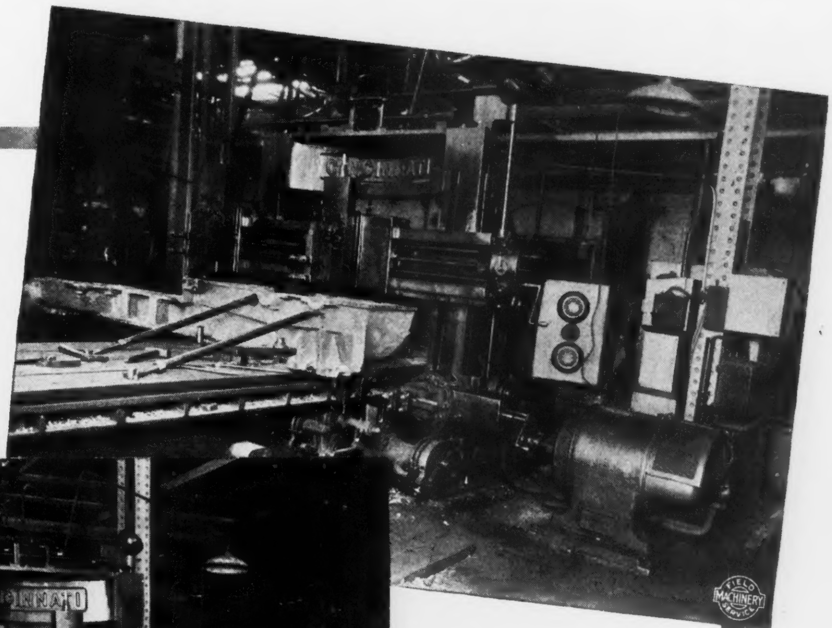
Cincinnati, Ohio, U. S. A.

Flat Turret Lathes ***Screw Machines*** ***Turret Lathes***

AGENTS:

DOMESTIC: Henry Prentiss & Co., Inc., New York City; Boston, Mass.; Buffalo, N. Y.; Syracuse, N. Y.; Rochester, N. Y.; Hartford. Motch & Merryweather Machinery Co., Cleveland, Ohio; Detroit, Mich.; Pittsburgh, Pa.; Cincinnati, Ohio. Marshall & Huschart Machinery Co., Chicago, Ill. Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Ind. Robinson, Cary & Sands Co., St. Paul, Minn. Elliott & Stephens Machinery Co. St. Louis, Mo. W. E. Shipley Machinery Co., Philadelphia, Pa. Kemp Machinery Co., Baltimore, Md. Seeger Machine Tool Co., Atlanta, Ga. C. T. Patterson Co., New Orleans, La. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. Dewstoe Machine Tool Co., Birmingham, Ala. Harron, Rickard & McCone, San Francisco, Los Angeles. FOREIGN: Aux Forges de Vulcain, Paris, France. Geo. H. Alexander, Birmingham, England. H. P. Gregory & Co., Sydney, Australia. J. Lambercier & Co., Geneva and Zurich, Switzerland. Chr. A. Herstad, Copenhagen, Denmark, and Stockholm, Sweden. Gustov Nielsen, A. S., Christiania, Norway. Maskin-Aktiebolaget E. Gronblom, Abo, Finland. Isbecque, Todd & Co., Brussels, Belgium. Andrews & George Co., Tokyo, Japan. Hijo de Miguel Mateu, Barcelona, Spain.

CINCINNATI PLANERS



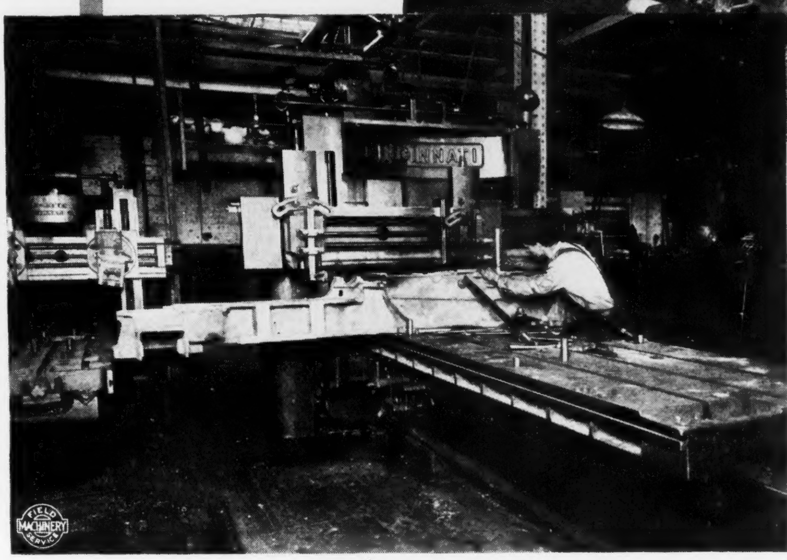


Photo and data procured through the courtesy of the Whiting Corporation, Harvey, Illinois.

Not a Hint of Trouble in Six Years

Quite a record for a machine that's had the steady and exacting service which has been required of this small "Cincinnati." The work shown is typical—a steel trolley-slide for a bucket crane, such as is used in large coal yards, to be machined practically all over, top, bottom and sides.

This casting is 10½ feet long, so more than half of it overhangs the 56″ Planer table; but owing to the unusual strength and rigidity afforded by the Double Plate Box Table and Herringbone Gears no difficulty was experienced in either clamping or feeding, and operations had progressed to the point of planing the bearing cap surfaces when the photos were taken.

Rapid Power Traverse minimizes idle time between cuts and rugged Box Arch and Cross Rail permit pushing the cutters to capacity.

Doesn't this performance suggest a possible application for Cincinnati Planers in your shop? Standard Planers 22″ to 120″; Open Side Planers, 30″ to 72″. Catalog on request.

THE CINCINNATI PLANER COMPANY

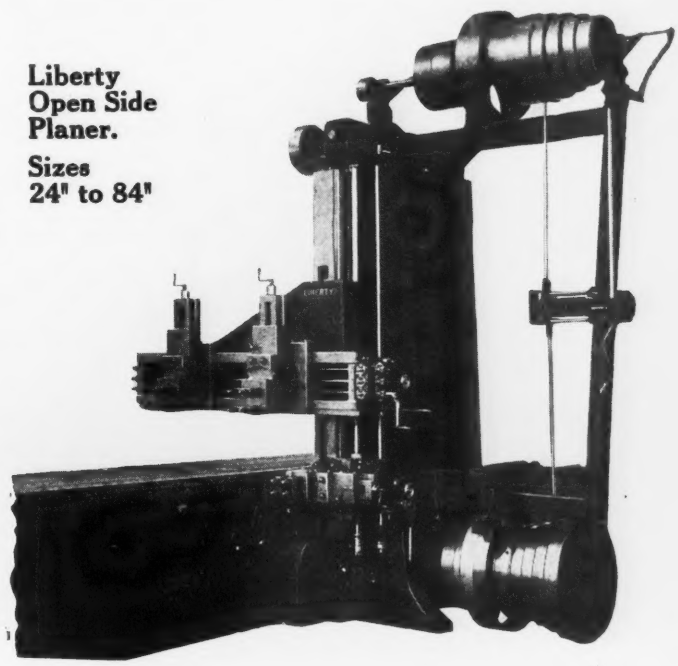
Cincinnati, Ohio, U.S.A.

Manufacturers of Planers and Boring Mills

LIBERTY MACHINE TOOLS

Liberty Open Side Planer.

Sizes 24" to 84"



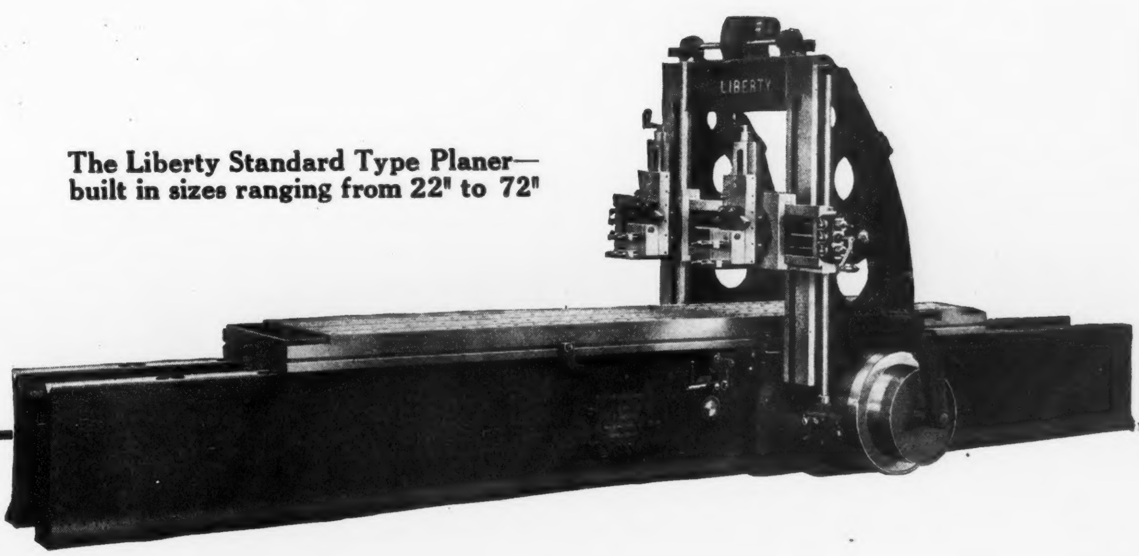
Liberty Planers

Are your machine tools equal to all demands? Are they efficient? Manufacturers are discarding tools of pre-war and war time periods which are not economical producers. Machine tools must have convenience of operation to be modern. They must be economical in the use of that high-priced commodity—labor. Liberty Planers, both Open Side and Double Housing Types, are upsetting traditions in planer design and operation. Take Liberty's latest development—the Quality Open Side Planer. Here you have a real centralized control, all operating devices within arms reach from one position, all parts interchangeable, patented features and feed mechanism, micrometer collars, clapper box clamp, 4-speed belt drive—and all other first class planer conveniences.

If you are considering a planer—send for a catalog—or better, visit our plant. It will pay you.

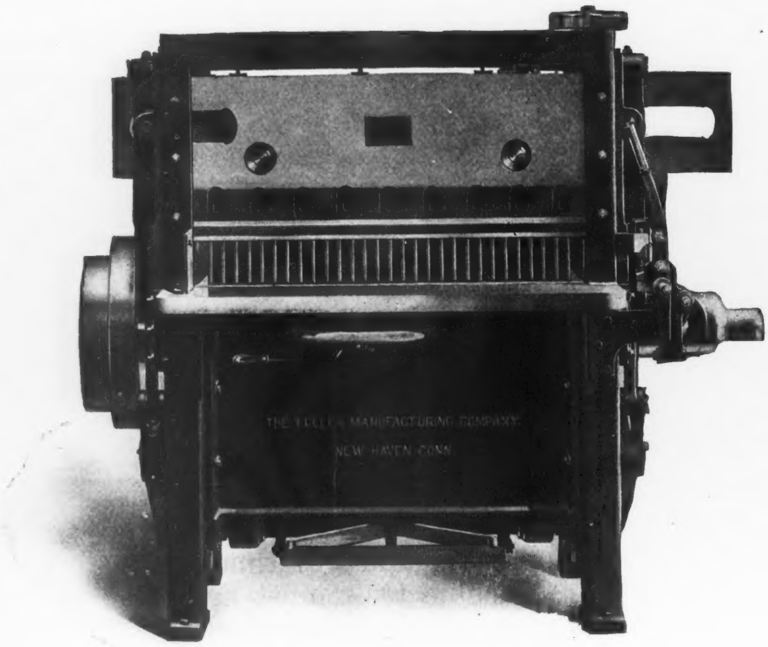
LIBERTY MACHINE TOOL CO., Hamilton, Ohio

The Liberty Standard Type Planer—built in sizes ranging from 22" to 72"



THE JOHNSON FRICTION CLUTCH

As Used on the White Paper Cutting Machine



Courtesy: E. C. Fuller Co., N. Y. City

A No. 8 Special Double Clutch installed as a part of each machine.

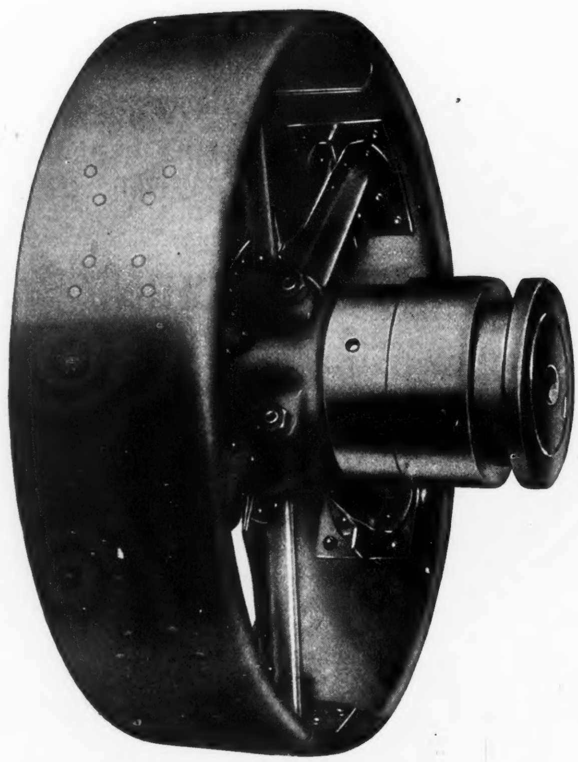
Many in use today that were installed 10 to 15 years ago.

"Friction Control" means "Better Machinery."

Consult the user and obtain his viewpoint, as to why a Johnson Friction Clutch is the real "Clutch Drive."

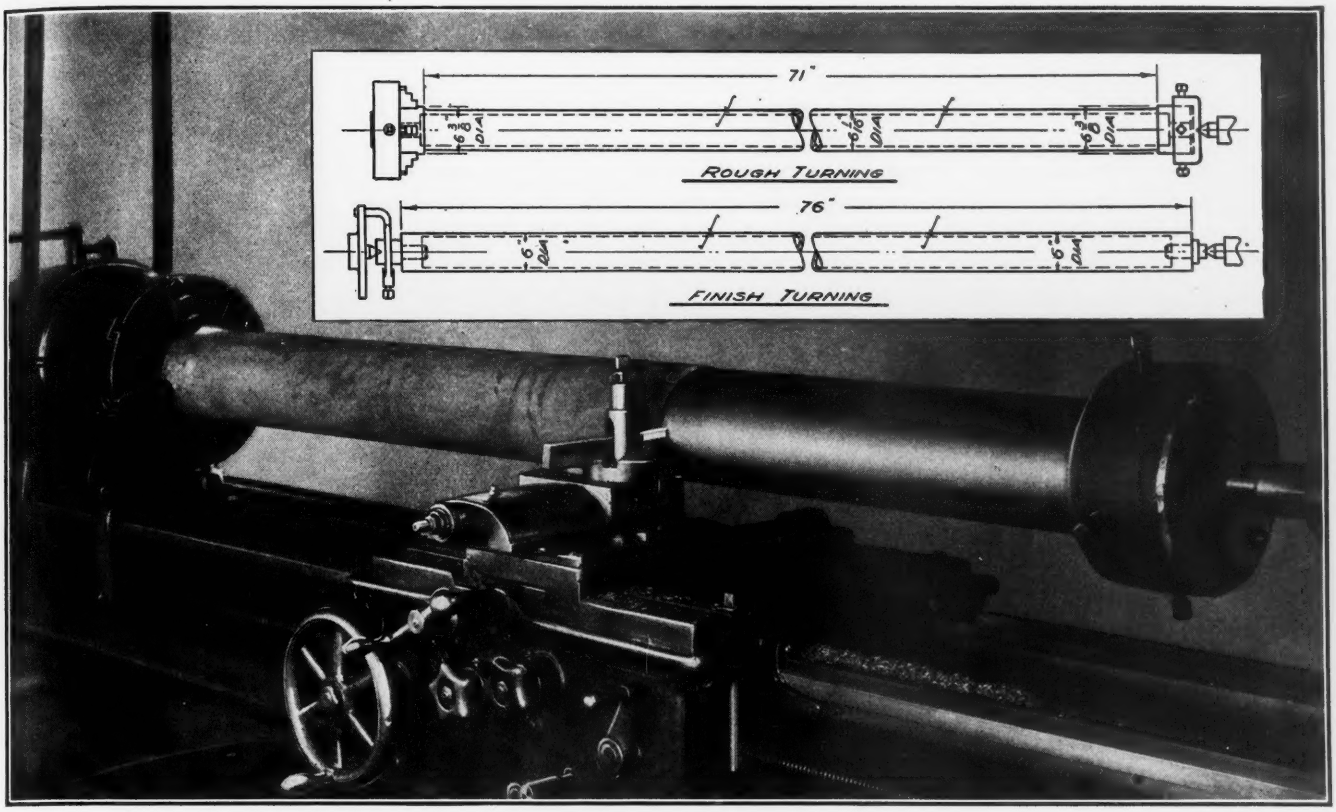
You may require a Johnson Friction Clutch on your paper working machine sometime. Why not consider the matter now so you will have the information at hand when desired?

Write for our Catalog "A"



Single Clutch With Pulley

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.



Turning Cast Iron Ink Fountain Roll

TIME STUDY

ROUGH TURN ROLL

	OTHER TOOLS	HAYNES STELLITE
Depth Cut	5/32"	5/32"
Cutting Speed	55'	82'
R. P. M.	35	52
Feed per Revolution	.050"	.051"
Cutting Time	41 min.	27 min.
Floor to Floor Time	56 min.	42 min.

Increased Production Based on Floor to Floor Time 33.3%

FINISH TURN ROLL

	OTHER TOOLS	HAYNES STELLITE
Depth Cut	1/32"	1/32"
Cutting Speed	82'	119'
R. P. M.	52	76
Feed per Revolution	.032"	.0325"
Cutting Time	46 min.	31 min.
Floor to Floor Time	61 min.	46 min.

Increased Production Based on Floor to Floor Time 32.6%

More Proof

That Haynes Stellite Cutting Tools Increase Production!

Wherever HAYNES STELLITE is applied you are sure to find its equivalent—INCREASED PRODUCTION—based either on the floor to floor time, or the tool life between grinds.

This has been proven time and again—in fact it is being *daily demonstrated* in some of the country's greatest plants. The record shown above is one of many. It was obtained in the shops of the Goss Printing Press Company at Chicago.

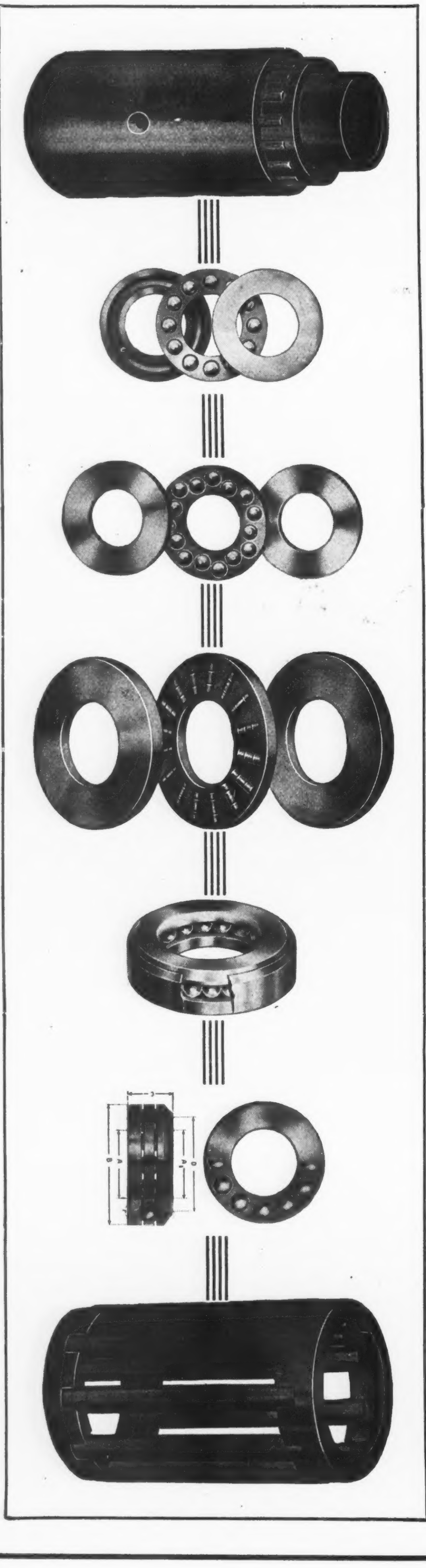
We are interested in your cutting problems. An inquiry sent to any of our offices will be given most careful consideration.

HAYNES STELLITE
CUTTING TOOLS

HAYNES STELLITE COMPANY

Carbide & Carbon Bldg.—30 East 42nd Street, New York

People's Gas Building, Chicago **General Motors Building, Detroit** **4503 Euclid Avenue, Cleveland**



Friction Is Costly

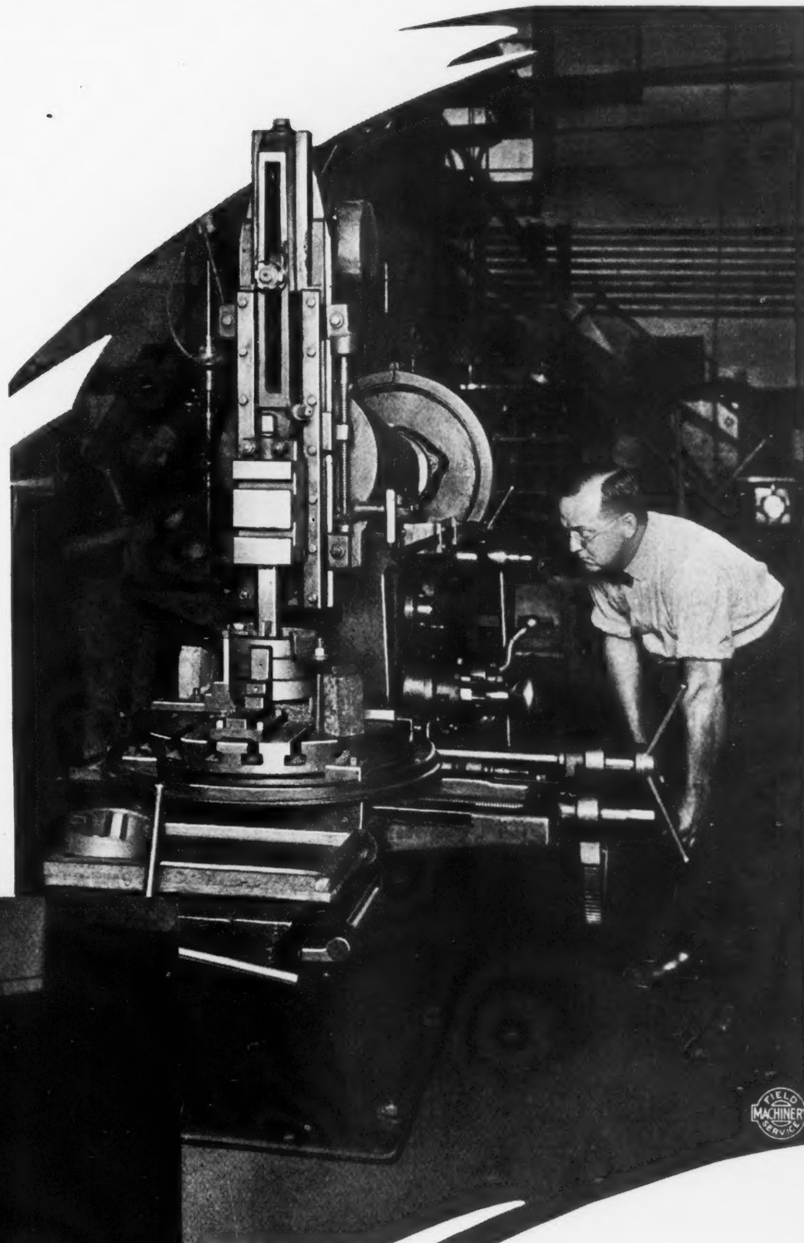
So costly that the progressive manufacturer welcomes every opportunity to nullify or reduce it. It wastes power, wears equipment and retards production.

Correctly chosen anti-friction bearings used wherever possible go far toward stopping the power leakage that adds so tremendously to the expense of manufacturing, reduce wear on the equipment, permit greater operating speeds and cut labor costs. All important factors in determining the price and profit of each piece of work. The cost of friction in the bearings can only be determined by the added profits that follow the installation of ball and roller bearings where they are needed. We can give you comparative figures based on results in other plants. Our engineers will be glad to show you what we can do for you.

The Ball & Roller Bearing Company

Danbury, Conn., U.S.A.

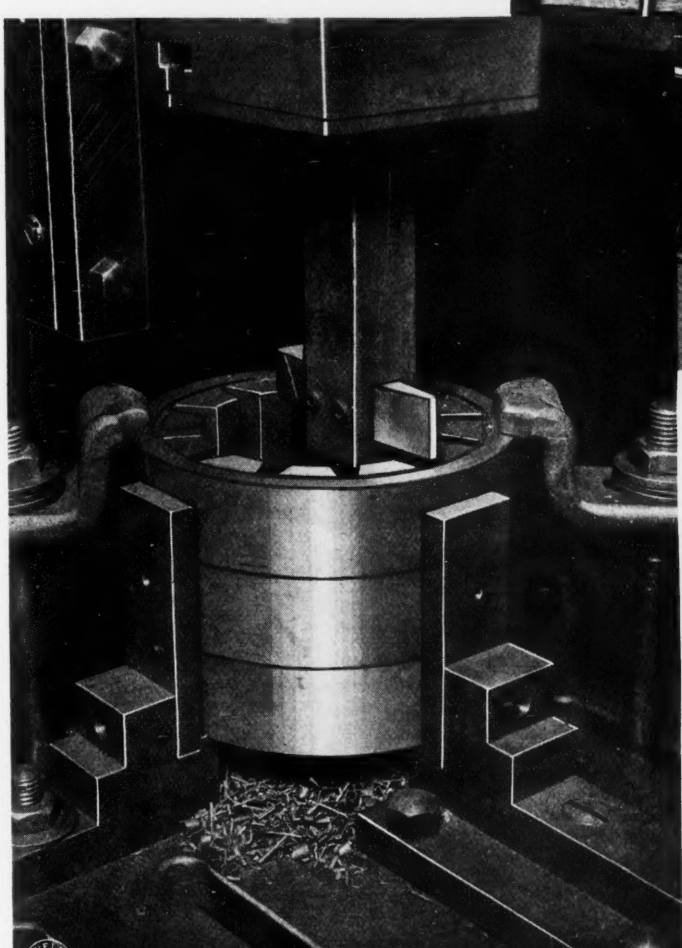
DILL SLOTTER



One Minute Per Slot—Thirteen Minutes Per Ring—How Would You Beat It?

Ranging from 2″ to 2′ in diameter, with tapered slots to be accurately finished to size, these rings presented a machining problem not economically solved until a Dill Slotter was installed to do the work.

The rings shown are gray iron, 7⅜″ outside diameter. There are 12 slots tapering from ¼″ to ½″ by ⅞″ deep by 1 11-16″ long—three rings are set up at once and 40 minutes floor to floor completes all of the them. Let us send you details of the features which make such production possible.



T. C. DILL MACHINE CO., Inc.

THE DILL SLOTTER PEOPLE

PHILADELPHIA, PA.

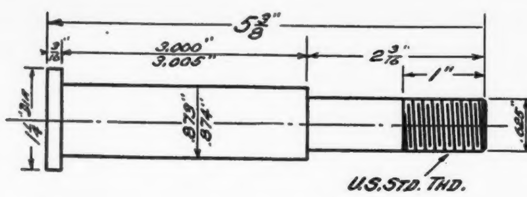
DOMESTIC AGENTS: Henry Prentiss & Co., New York City, Buffalo, Rochester, Syracuse, N. Y.; Boston, Mass.; Hartford, Conn. Motch & Merryweather Machinery Co., Cleveland, Detroit and Cincinnati. Marshall & Huschart Machinery Co., Chicago and Indianapolis. Brown & Zortman Machinery Co., Pittsburgh, Pa. W. E. Shipley Machinery Co., Philadelphia, Pa. Elliott & Stephens Machinery Co., St. Louis, Mo.

FOREIGN AGENTS: Alfred Herbert, Ltd., British Isles. Alfred Herbert, Ltd., Yokohama, Japan. Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium. Societe Anonyme Alfred Herbert, Ltd., Paris, France. Societa Anonima Italiana, Alfred Herbert, Ltd., Milan, Italy.

They're Using 7½ Year Old Chasers in this

HARTNESS DIE HEAD

The American Type Founders Company, Jersey City, N. J., finds the best way to insure belt tighteners against the inevitable vibration in service is to secure a close fit by using a Hartness Turret Lathe equipped with a Hartness Self-Opening Die Head, for the threading operation. Production averages 3½ minutes a piece, and though as noted above, the chasers have already seen 7½ years of service the threads are held to the same limits as the pins in which they are cut. Doesn't this record make you want to hear more about the Hartness Automatic Die Head?



JONES & LAMSON MACHINE CO., Springfield, Vermont

503 Market St., San Francisco, Cal. **9-10 Water Lane, Queen Victoria St., London, England**

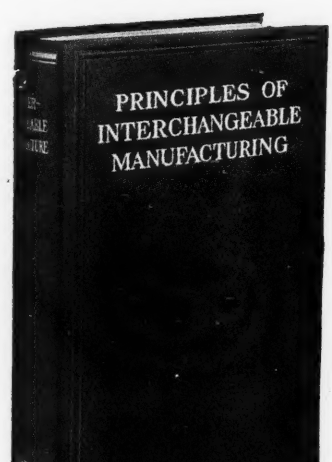
Principles of Interchangeable Manufacturing

By Major Earle Buckingham, A.S.M.E., S.A.E.

Engineer, Pratt & Whitney Co.

A treatise on the Basic Principles involved in Successful Interchangeable Manufacturing Practice covering Design, Tolerances, Drawings, Manufacturing Equipment, Gaging and Inspection.

This is the first complete treatise on interchangeable manufacturing, as a whole, that has appeared and *it was written by an authority*. The book defines and emphasizes the underlying basic principles, using specific methods to illustrate their application. The information upon which this treatise is based was gathered from many manufacturing plants both large and small in this country and Canada. Every method discussed is in successful operation and for that reason the book is of great value to the industry.



254 Pages—6x9 inches—Fully Illustrated

"Principles of Interchangeable Manufacturing" is bound in handsome green cloth, and is one of the MACHINERY Library Books on Shop Practice, Machine and Tool Design. Sent on Approval.

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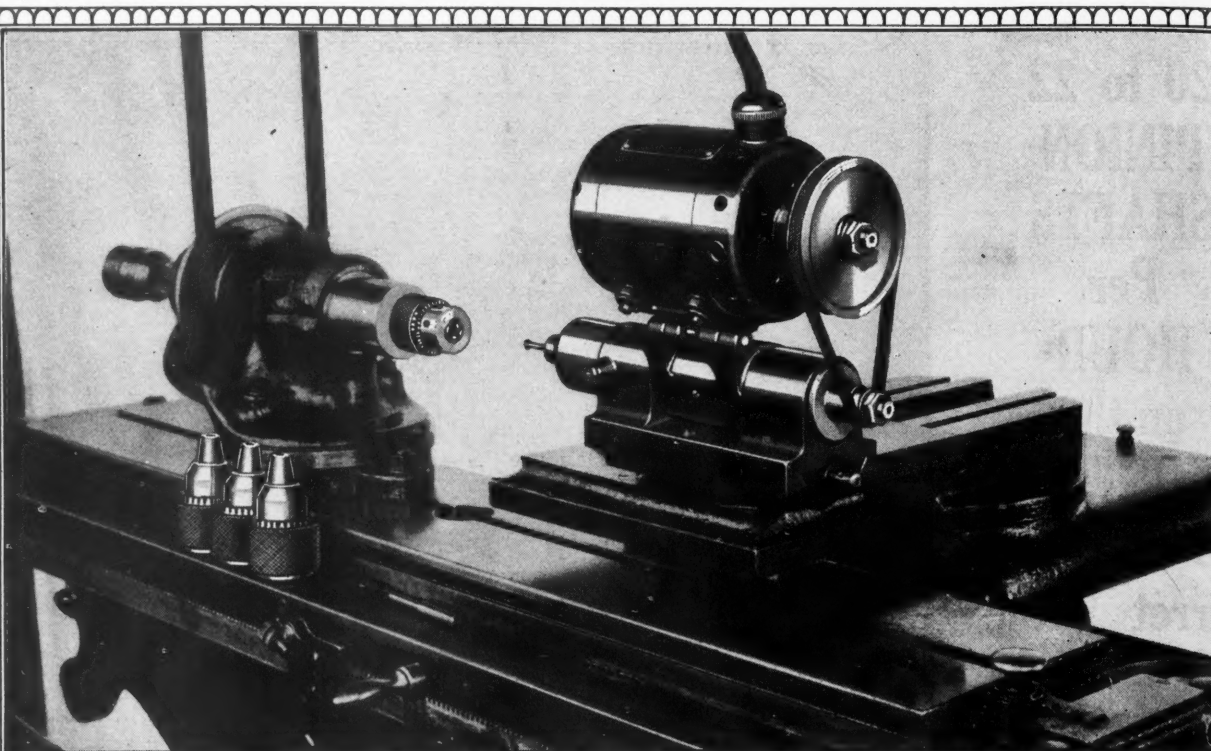


How DUMORE GRINDERS Solved a Difficult Grinding Problem on Jacobs' Chucks

WHERE accuracy is required such as is maintained in the thousands of drill chucks made by the Jacobs Manufacturing Company, it is necessary that the gripping points of the chuck jaws be ground after they are assembled into the body of the chuck.

That was the problem the Jacobs Mfg. Company had to solve. Heretofore, the manufacturers of these celebrated drill chucks had been making their own internal grinding spindles. The work of making them was very simple—but a spindle could not be made to run at the required high speed for more than eight or nine hours without developing bearing trouble. Consequently, daily renewals were necessary, involving tremendous expense and troublesome delays.

Numerous experiments were made to correct this condition. But none were successful—until a DUMORE No. 3 Grinder was introduced. Mounted as shown in the picture above,—dispensing with countershaft and belt drive—this sturdy DUMORE Grinder completed a run totaling 400 hours without developing a trace of bearing trouble. With the motor running 15,000 and the spindle running 50,000 r.p.m this DUMORE Grinder satisfactorily met Jacobs exacting standards even on small chucks, where a 1-16″ grinding wheel had to be used.

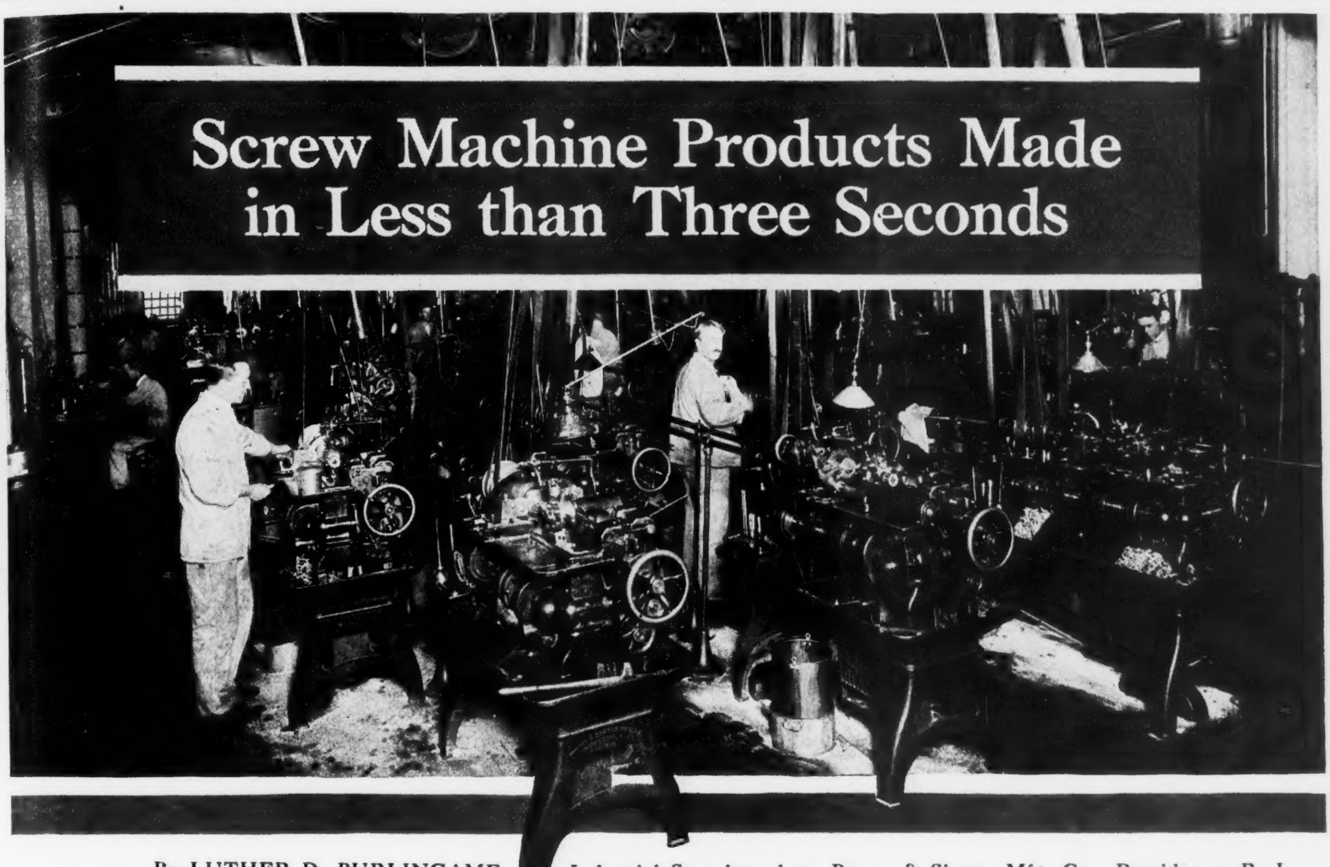
Perhaps you, too, are struggling with a grinding problem that could easily be solved with DUMORE High Speed GRINDERS. We have some interesting literature for you, illustrating their many uses. Write for it today—you'll find it chock full of valuable information.

WISCONSIN ELECTRIC COMPANY

2557 Sixteenth Street, Racine, Wis.

DUMORE HIGH SPEED GRINDERS

Screw Machine Products Made in Less than Three Seconds



By LUTHER D. BURLINGAME, Industrial Superintendent, Brown & Sharpe Mfg. Co., Providence, R. I.

Examples Showing how Rapid Production is Obtained by Careful Tooling and Machine Timing

In these days of split-second stop-watches, it is apparent how much depends on saving time to the fraction of a second; in some cases the difference between success and faiure may depend upon that fraction of a second. When many duplicate pieces of work are to be produced, a small saving in time on each piece may amount to a surprisingly large saving in the total, and when the time required to make a given piece is short, such a saving is relatively larger in proportion to the total time, thus representing a greater percentage of saving. This saving results in a lower wage cost per piece produced as well as a reduced overhead charge against the piece, and may mean the placing of an order for a rush job which would otherwise be lost.

In cases where the limitations of the machine and not the requirements of the work determine the time required to produce a part, means for performing operations simultaneously, for reducing idle movements, and for speeding up, may point the way to increased production. The cam system used on automatic screw machines permits operations to overlap each other and each tool can have the highest possible rate of feed and be set for the minimum length of travel required for a particular job. These conditions give maximum efficiency to the machine, and consequently lead to increased production.

Examples of saving in time by the use of a high-speed machine are most noticeable in working brass, aluminum, and other soft metals, but time savings can also be effected when cutting steel, if the diameter is small. Even when a high speed machine is not used, methods can be applied in handling jobs on regular automatic screw machines of the cutting-off, turret-forming, and full-automatic types. These methods consist of (a) using multiple lobes on the cam, (b) using more than one set of tools in the turret, and (c) producing more than one piece in a single cycle of operations. This article will describe some of these special methods, as applied to regular machines, and then deal with a high-speed machine, which, in addition to having the spindle operate at a speed suitable for soft metals, has also the possibility of taking advantage of the special methods pointed out, to make an additional saving.

Forming and Cutting off Parts in Less than Three Seconds

Three seconds is the minimum time for completing the cycle of operations on the regular line of No. 00 automatic screw machines made by the Brown & Sharpe Mfg. Co., including the No. 00 automatic cutting-off machine. It might be inferred from this statement that three seconds is the shortest time in which a piece of work can be produced, but the three examples shown at *A*, *B*, and *C*, in Fig. 1, are completed, respectively, in 1 1/3, 2½, and 2 seconds on the cutting-off machine, and show the possibilities of production in an even shorter time than three seconds.

Example *A* is made of machinery steel, 5/32 inch in diameter. The short production time of 1 1/3 seconds is made possible by using three sets of lobes on the cam, thus completing three pieces at each revolution of the camshaft. The gearing is timed for one camshaft revolution per four seconds, so that each piece is produced in one-third this time. The operations are (a) cutting off, using a tool on the front slide; (b) forming, using a tool on the back slide; and (c) feeding the stock to the stop. The piece is not cut off until after feeding the stock forward for the

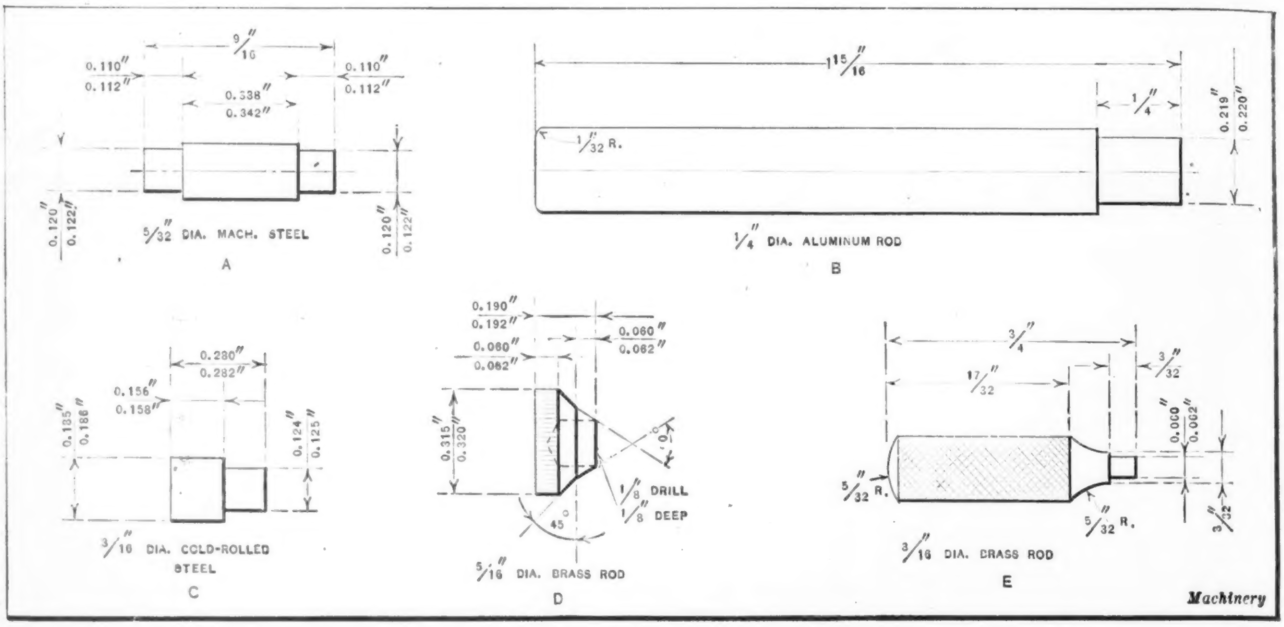


Fig. 1. Examples of Work produced in from One and One-third to Three Seconds in Automatic Cutting-off and Turret Forming Machines

next piece, so that three pieces are operated on simultaneously. While one is being cut off, the rear end of the next and the front end of the third are formed. The surface speed of the work is 98 feet per minute, and the net production is 2420 pieces per hour. This allows 10 per cent for changing stock and for contingencies; the same allowance is made in the net production on all examples given.

Example *B* is made from a ¼-inch aluminum rod, and, as in the first example, only cross-slide tools are required. Because the material is softer than that from which example *A* is made, it is possible to revolve the part at a higher surface speed, but the greater amount of stock removed and the time required to handle so long a piece necessitate a somewhat longer time for the cycle of operations. In this case the machine is timed for five seconds, and two lobes are provided on the cam, making the production time 2½ seconds for each piece and the net production 1280 pieces per hour. Details concerning this job are given on the estimate sheet, Fig. 3.

Example *C*, Fig. 1, is made of cold-rolled steel, 3/16 inch in diameter, the machine being timed for producing one piece in two seconds, even though the part is held to such close limits as 0.001 inch. This rate of production requires a surface speed of 118 feet per minute for forming. Two sets of lobes are used on the cam, and the gearing gives one revolution of the camshaft every four seconds. One piece is completed in 80 revolutions of the spindle, the net production being 2400 pieces per hour. In both this case and the preceding one, the cutting-off step is simultaneous with the forming step; however, a third piece is not operated on, as in the first example. The formed diameter of example *B* is also held to a limit of 0.001 inch.

Two Examples Requiring Turret Tools

Two brass pieces requiring the use of turret tools are illustrated at *D* and *E*. Reversal of the spindle is not necessary in machining these parts, and so a turret forming machine is adapted for this work. One of the pieces is given a short straight knurl, and drilled, while the other is given a diamond knurl. Each piece is completed in three seconds. Only two turret tools are required for example *D*, so by providing three sets of tools in the turret it is merely necessary to index this member one-third revolution to each revolution of the camshaft. These turret positions are used for stock stops and drills. The forming is done by a tool on the front slide, which produces two shoulders at angles of 45 and 30 degrees with the horizontal, and the knurling is done by a tool carried in a top knurl-holder; this is possible because of the short portion that is knurled. The cutting off is done by a tool in the back slide.

Indexing of the turret and drilling are coincident with the forming operation, and the first part of the cutting-off operation is coincident with the knurling. The operations are: (a) Feed stock to stop; (b) index turret; (c) form with tool on front slide; (d) drill; (e) knurl; (f) cut off; and (g) index turret. A total of 120 spindle revolutions are made in completing one piece, and the net production obtained on this job is 1080 pieces per hour.

As example *E* has a longer knurled portion, the knurl must be carried in the turret. However, indexing of the turret is avoided in this operation by using the front cross-slide as a stop in feeding the stock, and doing the forming and cutting off by means of tools held on the back cross-slide. Another advantage of this set-up is that only one knurling tool is required. The different steps in this operation are: (a) Feed stock to the front cross-slide;

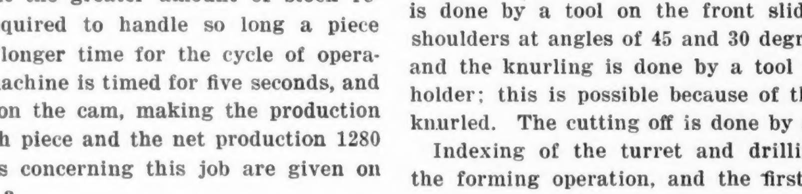


Fig. 2. Two Examples produced on a Regular Type Automatic Screw Machine, and on a High-speed Machine

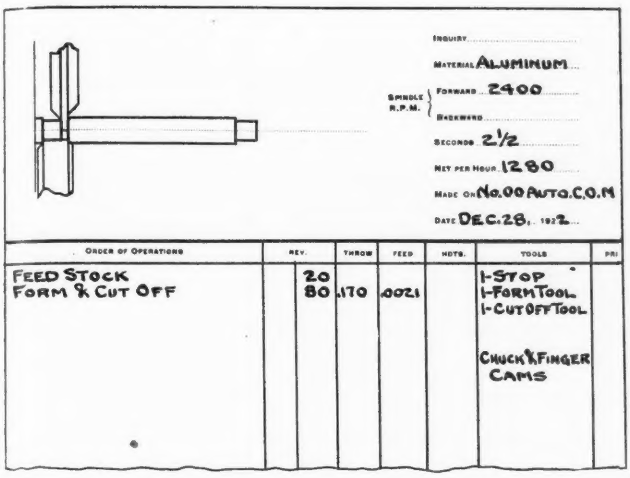


Fig. 3. Estimate Sheet which gives Data concerning the Operation on Part B, Fig. 1

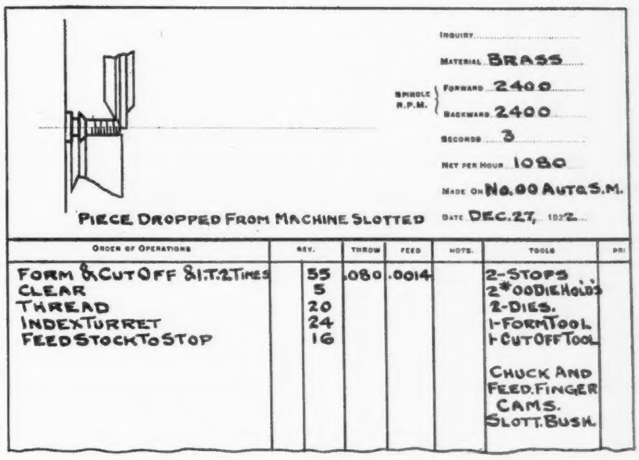


Fig. 4. Specifications Relative to the Machining of the Brass Screw A, Fig. 2

(b) knurl; (c) form; and (d) cut off. The net production is 1080 pieces per hour.

Two Threaded Parts

A brass screw made from 5/16-inch stock, formed, threaded, and slotted in three seconds is illustrated at *A*, Fig. 2. While such a screw could be produced on a machine on which there was no provision for reversing the spindle, as for instance, on the B. & S. No. 00 turret forming machine, using an opening die-head, it can be made to better advantage and with a cheaper tooling equipment on the full automatic type of screw machine in which the spindle does reverse. The use of the slotting attachment makes it possible to slot the screw-head simultaneously with the other operations. Only two turret positions are required for this job, one for the stop and one for the die, and so the machine is set up with duplicate sets of tools in the turret, and the turret is indexed half way around to each revolution of the cam. The reason for not using three sets of tools is that the indexing of the turret is done while the forming, cutting-off and slotting steps are in process, so that no further time could be saved by providing another set of turret tools. The slotting requires about three seconds. Each screw is completed in 120 revolutions of the spindle, the net production being 1080 pieces per hour. Details of this job are given on the estimate sheet Fig. 4.

Another example of work that is suited to the full-automatic machine is the steel screw *B*, Fig. 2, which is produced from ⅛-inch cold-rolled steel in three seconds. The cutting off is done at a maximum speed of 78 feet per minute, with the spindle running backward at 2400 revolutions per minute, and the threading is done at a surface speed of 29 feet per minute, with the spindle running forward at 927 revolutions per minute.

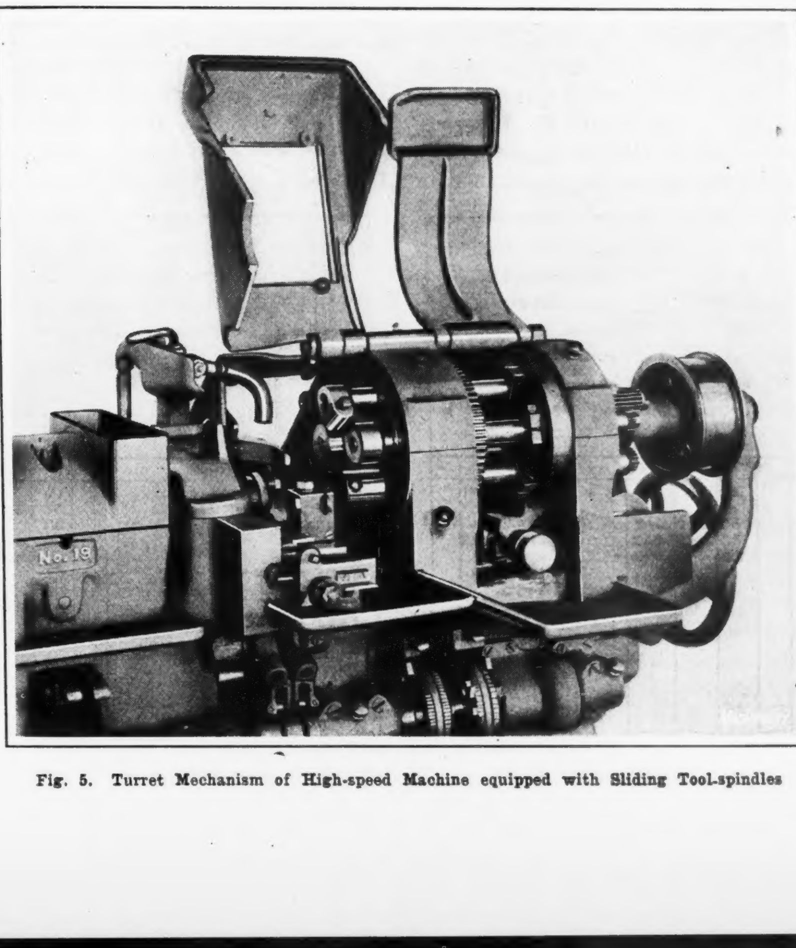


Fig. 5. Turret Mechanism of High-speed Machine equipped with Sliding Tool-spindles

As with part *A*, two sets of turret tools are used. The operations are: (a) Feed to stop; (b) index turret; (c) thread; (d) clear; (e) cut off; and (f) index turret. The examples given in the foregoing are produced on machines of regular types provided with ordinary tool equipment. Additional time can often be saved on work to be done in large quantities by providing special equipment or tools, such as a revolving drilling attachment which will give a drilling speed equivalent to the sum of the spindle and drilling attachment speeds.

Design of a High-speed Automatic Screw Machine

The B. & S. No. 19 automatic screw machine has a maximum spindle speed of 5000 revolutions per minute, and is especially adapted to high-speed work. On this machine it is possible to complete the cycle of operations in two seconds. In order to insure satisfactory results at such a high speed, the spindle bearings are lubricated and cooled by means of a forced circulation of oil, which is passed through a jacket surrounding the outside of the bearings to cool them, while a sufficient supply is introduced to the bearings for lubricating purposes. In addition to this provision for keeping the bearings cool and well oiled, the strain of driving is entirely removed from the bearings by mounting the driving pulleys on sleeves that are supported independently of the spindle in such a manner that no strain is transmitted to the spindle. The pulleys run on roller bearings; the friction clutches are made of extra width and have phosphor-bronze rings that engage hardened steel surfaces; and the end thrust of the spindle, clutch ring, chuck-operating sleeve, and feed-tube, are taken by ball bearings.

On this machine the turret design is such that each tool is moved independently

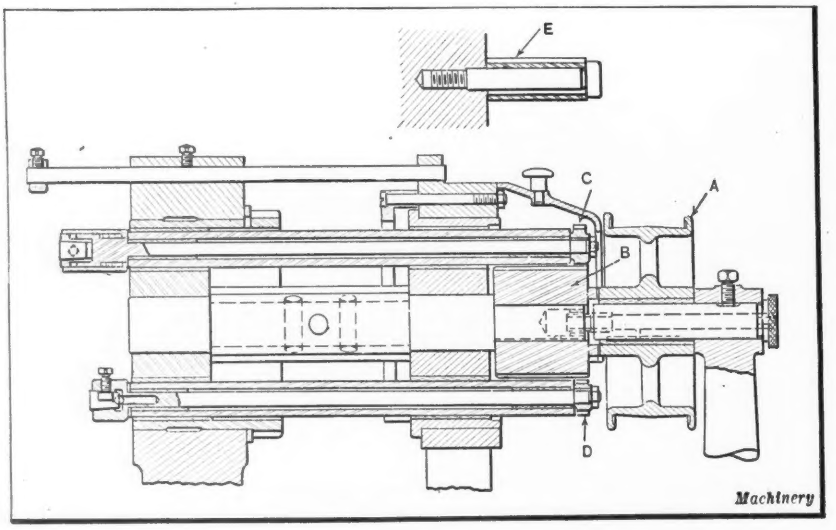


Fig. 6. Driving Mechanism for the Tool-spindles

toward and away from the work without having to move the heavy turret. The turret unit is shown in Fig. 5. To limit still further the moving of parts to those that are as light as possible and that may be operated rapidly, an auxiliary or supplementary slide is provided, which is disconnected from the main slide during part of the operation, as will be explained later. The time required for feeding the stock and indexing the turret is one-third of a second.

The operating mechanism of the auxiliary slide is illustrated diagrammatically in Fig. 9. The turret *A* carries the tool-spindles, and these are engaged by block *B* as they are successively indexed into the operating position. The main slide *C* carries the auxiliary slide *D*, the former being mounted on the bed of the machine. A crank *E*, which is also mounted on the main slide, is connected to the auxiliary slide through a two-part connecting-rod *F*. A latch holds the two connecting-rod parts together except during the quick-return and quick-advance motions, which are effected by revolving the crank disk *E*. The latch is disengaged by passing over cam *G*, thus breaking the connection with the auxiliary slide for the quick-return and the quick-advance movement up to the point of cutting. By this arrangement only the lightest parts are moved during this part of the operation.

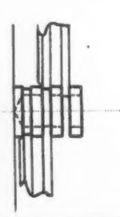
Instead of having the main spindle reverse on this machine, a second speed in the forward direction of 1450 revolutions per minute is provided. Thus, withdrawing of the tap or die-head after a threading operation can be accomplished by utilizing the differential speed between the main spindle and the revolving tap or die-holder carried in the turret. The turret tools are driven from pulley *A*, Fig. 6, through gear *B*, and either of pinions *C* and *D*. When it is desired to revolve a tool-spindle in the same direction as the main spindle so as to obtain a differential speed, direct connection is made to the tool-spindle through gear *B* and pinion *C*. However, when it is desired to reverse the direction of a tool-spindle so as to obtain the sum of the two speeds, as for instance, in drilling, the smaller pinion *D* is used, which is connected with gear *B* through the intermediate pinion *E* shown in the view at the top of the illustration.

In tapping or threading operations, the tap or die runs at a speed of 2500 revolutions per minute, in the same direction as the main spindle, thus giving a cutting speed of 2500 revolutions per minute, but when the tap or die is run off the work, the main spindle revolves at 1450 revolutions per minute, and as the tool-spindle runs at the same speed as before, the difference in speeds gives 1050 revolutions per minute as the backing-off speed. In drilling, the drill spindle revolves in the opposite direction to the main spindle at a speed of 3350 revolutions per minute, and so the drilling speed is the sum of the maximum main spindle and the drill spindle speeds or 8350 revolutions per minute.

A swinging stock stop which operates in unison with the chuck permits a full set of six working tools to be carried in the turret, and eliminates the usual extra indexing of the turret for the stock stop. Provision is made for stopping the machine when the supply of stock is exhausted, the chuck being left open so that a new piece can be inserted. The work is inserted from the machine end of the wire stand, which can be swung out of line with the spindle to permit of this, after which it is swung back and locked in position. Because of the advantages of a high-speed spindle, light moving parts, and revolving turret tools, this machine is well suited to work which allows of rapid cutting and especially to drilled work or that on which long turning operations are required; it is also suited to work for which idle movements of the machine parts take up a considerable proportion of the total time.

Examples of Work Produced on the High-speed Automatic Screw Machine

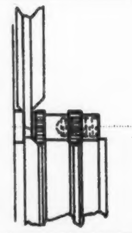
Examples of work produced in less than three seconds with a B. & S. No. 19 automatic screw machine are shown at *C*, *D*, and *E* in Fig. 2. Part *C* is a brass ring produced from solid stock with the corners chamfered. The machine



Inquiry ......
Material BRASS
Spindle R.P.M. { Forward 5000; Backward ......
Seconds 4 PCS. IN 2.95 SEC. 1 PC. IN .725 SEC.
Net per Hour 4320
Made on No. 19 AUTO. S.M.
Date DEC. 28, 1922

Order of Operations	Rev.		Throw	Feed	Hdts.	Tools	Pr.
FEED STOCK TO SW. STOP		33				1-DRILL HOLDR	
CLEAR		10				1-DRILL	
DRILL		30	.300	.010		1-DRILL BUSH.	
CUT OFF 1ST PIECE		33	.065	.002		2-CUT OFF TOOLS	
CUT OFF 2ND PIECE		20	.040	.002			
						CHUCK & FING. CAMS.	

Fig. 7. Estimate Sheet giving Data Relative to Part C, Fig. 2



Inquiry ......
Material BRASS
Spindle R.P.M. { Forward 5000-2500; Backward ......
Seconds 2.9
Net per Hour 1117
Made on No. 19 AUTO. S.M.
Date NOV. 15, 1922

Order of Operations	Rev.		Throw	Feed	Hdts.	Tools	
CLEAR		10				2-KNURL HOLD'S	
KNURL & CENTRE		32	.370	.030 .004		2-CENT. DRILLS	
INDEX TURRET		27				2-DRILL HOLD'S	
FORM			.015			2-TWIST DRILLS	
DRILL		30	.180	.003		2-DRILL BUSH'S	
INDEX TURRET		27				2-TAP HOLDERS	
TAP		28				2-TAPS	
CUT OFF		62	.090	.0015		2-TAP BUSH'S.	
FEED TO SW. STOP & I.T.		27				1-CUT OFF TOOL	
						1-FORM TOOL	
						1-CHUCK	
						1-FEED FINGER	
						2-STOPS	
						1-SET CAMS	

Fig. 8. Order of Operations and Tooling Equipment for Part E, Fig. 2

time per piece is less than three-quarters of a second. The reason that this can be done in so short a time is that two pieces are produced simultaneously, the cutting-off tool for the first piece being set enough ahead of that for the second so that when the first piece drops, the second one is still supported sufficiently to carry the cut. In this case two sets of lobes are provided on the cam, four pieces being produced at each complete revolution of the camshaft, the timing of the machine being 2.9 seconds. The tooling and order of operations for this piece are shown on the estimate sheet in Fig. 7.

The part illustrated at *D*, Fig. 2, is a brass shouldered bushing turned from ⅜-inch stock, which is the maximum size that can be handled in the machine. The time required for completing this piece is 1¾ seconds. This is a case where a material saving of time as well as reduction in the wear and tear on the machine can be effected by using the swing stock stop. Because of this type of stop, it is not necessary to index the turret on this job, the only operation requiring a turret tool being drilling. This method allows the drill to start practically as soon as the stock is fed, without the delay that would be caused if it

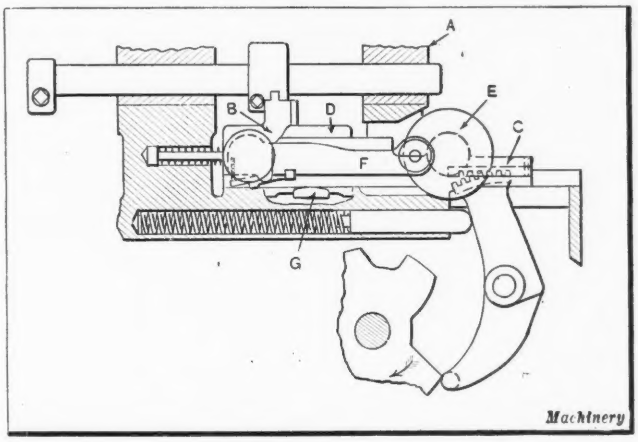


Fig. 9. Operating Mechanism of the Auxiliary Slide carried on the Main Slide

were necessary to wait for the turret to index to the next position. Two sets of lobes are used on the cam, and the gears give one revolution of the camshaft in 3.5 seconds. The operations are: (a) Drill; (b) form (these two operations being performed simultaneously); (c) cut off; and (d) feed stock. The spindle makes 143 revolutions during the machining of each bushing, and the production is 1840 pieces per hour.

The knurled and tapped brass piece *E* is produced in 2.9 seconds. This piece requires but three turret positions for the tools, because of the swing stop for use in feeding the stock. Therefore, two sets of tools can be used in the turret, and the latter is indexed half way around to each revolution of the camshaft. Full specifications of the tooling equipment for this job are given in the estimate sheet in Fig. 8.

In a number of the examples given in this article a single workman operating several machines of either of the types described can produce from five hundred thousand to a million pieces in a week without working over-time. Examples could also be shown of work completed within three seconds time on machines of larger size, but naturally the greater percentage of such work is done to better advantage on small machines. Much work that requires more than three seconds for its completion on both large and small machines can have the time materially reduced by studying time-saving methods adapted to the particular job.

* * *

The Mechanical Division of the American Railway Association has decided not to hold its regular convention for 1923. Instead, a special business session was held in Chicago early in the year.

MAKING WELDED STEEL TUBING—COMMENT

By R. POLIAKOFF

In February MACHINERY an article was published entitled "Making Welded Steel Tubing," in which the processes used by the Standard Welding Co. of Cleveland, Ohio, were described. The author does not say whether the flat stock used for rolling the tubes into shape is fed into the rolling machine hot or cold, but judging from the number of pairs of rolls shown in the machine in Fig. 1, and by the number of gradual deformations which the strip undergoes, as indicated, as well as taking into account the author's statement that the strip steel is fed into the machine from a coil, it may be concluded that the tubes are rolled cold.

The writer has had considerable experience with the manufacture of tubes of the kind described, having completely equipped one such plant and run it for some time; he knows also how some other plants of the same nature are equipped and run. In the plant of which he had charge there were rolling machines of two kinds, those in which the strip is rolled cold, and those in which the strip is rolled hot. On the basis of this experience, the conclusion was reached that when large production is the paramount object, the hot-rolling machine is the best: Its output, as compared with the cold-rolling machine is many times higher; it is simpler in construction—three or not more than four pairs of rolls being required instead of the seven pairs necessary in the cold-rolling machine; consequently, there is a smaller number of such rolls to be re-turned, reshaped, reground, etc. But that is not all. When a cold-rolling machine is used, the strips have to be dimensioned very accurately as to width; otherwise the joint of the tube, which has to be a butt joint, will not close at all if the strip is too narrow, or may become an overlapping joint if the strip is too wide. Again, if the strip is too wide, the edges may close at an angle, and extend outside of the circumference of the tube of the proposed diameter.

In the cold-rolling process the metal of the strip has to be of a special quality. When hot-rolled, the material can be of an inferior and therefore cheaper quality; less accuracy is required in the width of the strip as, being fed into the machine hot, that is, in a more pliable condition, it assumes more readily the required shape. As against the advantages mentioned, the necessity of heating the strips has to be considered—a furnace has to be provided, the best place for which is behind the rolling machine so that the strip can be fed into it directly from the furnace. This eliminates, on the other hand, the coil stand.

The speed of the welding machines, whether they are electric welders or whether the oxy-acetylene flame is used, is necessarily not very high, irrespective of whether the cold-rolling or hot-rolling method is used. In the hot-rolling method, it is possible to get, say, the whole weekly output of the plant ready for welding, and for the surface finishing machines in a day or two, depending on the sizes of the tubes to be produced and their quantity, and both the furnaces and the rolling machines can be stopped for the remainder of the week, and the workmen employed on the other machines. In other words, the number of men necessary for the hot-rolling process is less.

* * *

The scarcity of coal in Germany has increased the interest in the use of the tides for power purposes. Investigations have shown, however, that the cost of producing power in this way by any means yet known, is too high, compared with other power sources. The difference in the levels of the tides on the German coast are nowhere nearly as great as they are on the English coast, and what might be possible in certain parts of England is considered impracticable on the German shore.

Power Calculations for Bending Rolls

By A. L. ROBERTS

IN this article no claim for originality is made, but the method here outlined for calculating the strength and deflection of bending rolls and the power required to bend flat plates should be of assistance to beginners in adopting the proper sequence for calculating such problems.

In designing bending rolls, the first step is to determine the diameter of the rolls, considering both the strength and the deflection under full load. Referring to Fig. 1, if the top roll is supported by a flat plate resting on the two bottom rolls, and no pressure is applied, the points of support are a distance L apart, and no bending occurs. As pressure P is applied to the top roll, bending will occur in the plate which will result in the points of support changing as represented by span W. The amount of pressure required to bend the plate permanently to radius R is the maximum pressure and when the plate has been bent to this extent, the elastic limit of the material has been exceeded. This maximum pressure must be used in the calculations for strength, deflection, and horsepower requirements.

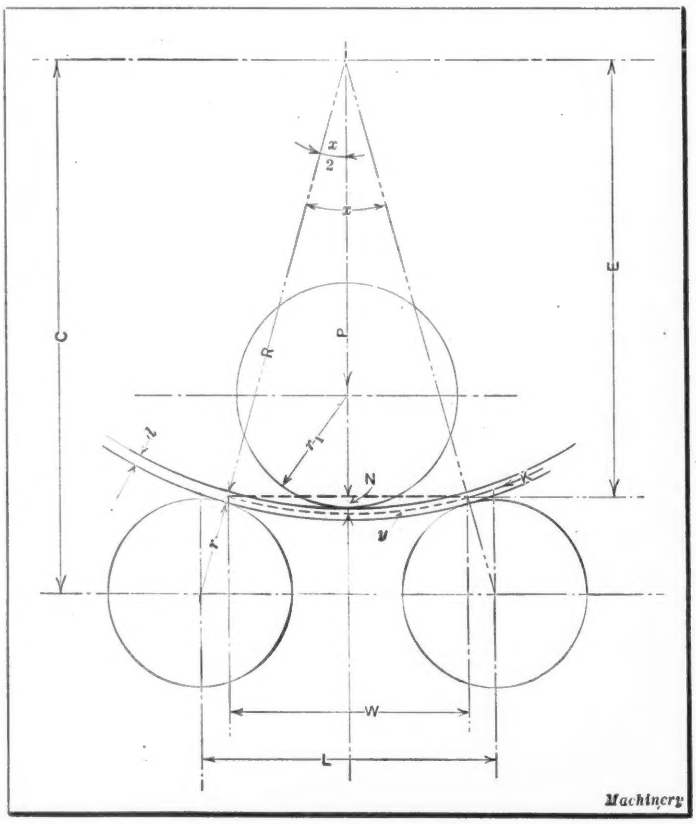


Fig. 1. Diagram illustrating Application of Forces on Bending Rolls

If the points of support were not changed by the application of pressure, as in a beam, the bending moment M would be equal to $PL \div 4$, L being the center distance of the bottom rolls in inches. If the width of the plate in inches be represented by b, the thickness in inches by d, and the safe stress in pounds per square inch by S, the resistance to bending equals $bd^2S \div 6$, and this value is equal to the bending moment; that is,

$$\frac{PL}{4} = \frac{bd^2S}{6} \text{ or } P = \frac{2bd^2S}{3L} \qquad (1)$$

For the maximum value of P, the bending moment M is equal to $PW \div 4$, but since

$$W : L = R + \frac{d}{2} : R + d + r$$

$$W = \frac{L\ (R + d \div 2)}{R + d + r} \qquad (2)$$

in which

R = inside radius to which plate is bent; and r = radius of bottom rolls.

Substituting this value of W for L in Formula (1) and transposing,

$$P = \frac{2bd^2S\ (R + d + r)}{3\ L\ (R + d \div 2)} \qquad (3)$$

Calculations for Safe Working Stress

The maximum bending moment for the top roll can be calculated by the formula found on page 350 of MACHINERY'S HANDBOOK for a beam uniformly loaded for a part of its length. The bending moment will then be:

$$M = \frac{PA}{8}\ (1 + 2k) \qquad (4)$$

in which

P = load in pounds as found by Formula (3);

A = length in inches of roll from center to center of bearings; and

k = fraction of length of rolls at each end that is not loaded (see Fig. 2).

The value of k is obtained by dividing the distance from one edge of the plate to the center of the roll bearings by the center distance A of the bearings. When the width of the plate to be bent is approximately the same as the length of the body of the rolls, the value of k is so small that it has but little effect either on the bending moment or on the deflection. This value, however, has considerable effect when stresses and deflections are being calculated for a plate that is considerably less in width than the length of the body of the rolls.

The section modulus Z of the top roll equals $0.0982\ D_1^3$, D_1 being the diameter of the top roll in inches. The permissible working stress S, on the top roll is $M \div Z$. Referring to Figs. 3 and 1 the pressure on the top roll may be considered as the resultant of the two forces Q acting on the two bottom rolls, from which

$$Q = \frac{P}{2} \times \frac{R + d + r}{C} \qquad (5)$$

and

$$C = R + d + r\left(\cos\frac{x}{2}\right) \qquad (6)$$

In considering the strength of the bottom rolls, the same basic formulas as are used for the top roll are applied. The bending moment for the bottom roll will be

$$M = \frac{QA}{8}\ (1 + 2k) \qquad (7)$$

The section modulus Z in this case equals $0.0982D^3$, D being the diameter of the bottom rolls in inches. The safe working stress S in the bottom rolls is $M \div Z$.

Calculations for Deflection

The deflection f of the top roll due to load P is

$$f = \frac{PA^3}{384\,EI\,(1-2k)} \times (5 - 24\,k^2 + 16\,k^4) \qquad (8)$$

in which

E = modulus of elasticity = 29,000,000 for steel;

I = moment of inertia;

k = fraction of length of rolls at each end that is not loaded.

The deflection f_1 of the bottom rolls due to load Q, acting in the direction OQ, may be similarly expressed, thus,

$$f_1 = \frac{QA^3}{384\,EI\,(1-2k)} \times (5 - 24k^2 + 16k^4) \qquad (9)$$

Formulas (8) and (9) for deflection are from MACHINERY'S HANDBOOK, page 350.

The deflection of the top roll due to its own weight should also be computed, and since it acts in a contrary direction to load P it should be subtracted from f. The value of f_1 as calculated by Formula (9), will give the deflection of the bottom rolls in the direction of the pressure resulting from load Q; that is, the angular deflection. Sometimes roller bearings are placed as supports, under the bottom rolls, and then all deflection of the bottom rolls can be disregarded. If, however, roller bearing supports are not used, the angular deflection should be reduced in the proportion of the distance C to $(R + d + r)$, and this will give the vertical component of this deflection parallel to the deflection of the top roll; that is, the deflection in a vertical direction.

The deflection of the bottom rolls due to their own weight must also be computed and this deflection added to the vertical deflection, since it acts in a downward direction. The total deflection F may be expressed by the formula

$$F = f - f_2 + f_1 \frac{C}{R + d + r} + f_3 \qquad (10)$$

in which

f = deflection of top roll due to load P;

f_1 = deflection of bottom rolls due to load Q;

f_2 = deflection of top roll due to its own weight; and

f_3 = deflection of bottom rolls due to their own weight.

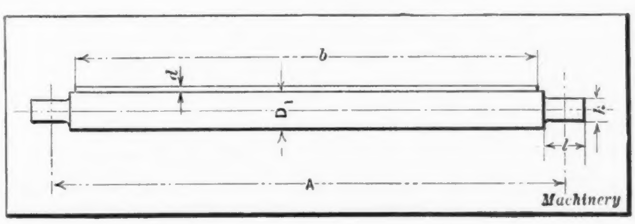


Fig. 2. Bending Roll and Dimensions used in the Calculations

It will generally be found for rolls of this kind, where wide plates are to be bent, that deflection is the governing factor. Sometimes the stress in the rolls will be comparatively low, since the diameter must be sufficient to maintain the deflection within reasonable limits. Both the top and bottom rolls may be enlarged slightly at the center to compensate for the deflection, and will thus have a slight taper toward each end.

Power Required for Driving the Rolls

The power to drive the rolls depends upon the speed of rolling. Ten feet per minute is good practice for medium sized rolls, but this rate is sometimes exceeded for small rolls and correspondingly reduced for rolls of large size. In Fig. 1 the pressure P acts through a distance N to bend the plate to radius R, while the forces K required to drive the plate through the rolls, is acting through arc y, the chord of which is W. Therefore $PN = Ky$ and

$$K = \frac{PN}{y} \qquad (11)$$

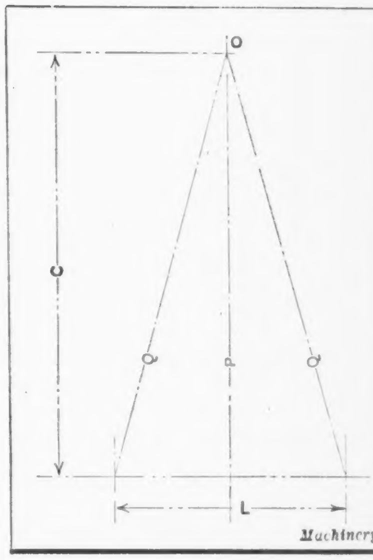


Fig. 3. Diagram used in investigating the Resultant Load on the Lower Rolls

It will be found that the power required for the actual bending of the plate is quite small in comparison with the friction load, the latter ranging from four to eight times the former. The horsepower formula for bending the plate without friction is

$$\text{H. P.} = \frac{Ks}{33{,}000} \qquad (12)$$

in which s represents the speed of the plate through the rolls in feet per minute.

In Fig. 1 the length of arc y, whose chord is W, can be calculated by first solving the angle x;

$$\text{Sin}\ \frac{x}{2} = \frac{W \div 2}{R + d \div 2} \qquad (13)$$

Then,

$$y = \frac{x}{360} \times 2\pi \left(R + \frac{d}{2} \right) \qquad (14)$$

The length of arc y can also be obtained by using a table of values for segments of circles, such as found on page 62 of MACHINERY'S HANDBOOK. Divide W by $\left(R + \frac{d}{2} \right)$ to obtain the chord for a segment of radius 1; then from the table select this value and the corresponding value for the arc, multiplying the latter value by $\left(R + \frac{d}{2} \right)$. This will give the length of arc y; its height N can also be readily found from this table or it can be calculated thus:

$$N = \left(R + \frac{d}{2} \right) - E \qquad (15)$$

$$E = \left(R + \frac{d}{2} \right) \cos \frac{x}{2} \qquad (16)$$

Fig. 4 is a diagram of a case where the plate to be bent is thin. When the thickness of the plate is small, Formula (3) for pressure P can be slightly simplified by omitting the plate thickness d, since it is but small in comparison with R and r. The formulas for bending a thin plate may then be stated thus:

$$W = \frac{LR}{R + r} \qquad (17)$$

and

$$P = \frac{2\,bd^2 S\ (R + r)}{3\,LR} \qquad (18)$$

Application of Formulas—Strength

A calculation to show the application of the formulas will now be made, the problem being to determine the size, strength, deflection and required horsepower for a set of rolls to bend a plate ¾ inch thick and 20 feet wide, to an inside diameter of 6 feet, at the regulation speed of 10 feet per minute. It is assumed that the diameter of the top roll is 18 inches, the diameter of the bottom rolls 15 inches, and that the bottom rolls are spaced 24 inches apart, center to center. Using the reference letters found in the accompanying diagrams and the assumed values for the problem, the data may be arranged in the following form:

$b = 20$ feet $= 240$ inches; $S =$ safe stress of material or
$d = 0.75$ inch; 45,000 pounds per sq. in.
$R = 36$ inches; $A = 260$ inches;
$r = 7.5$ in.; $D = 15$ in.; $h = 10$ in. for top roll and
$r = 9$ in.; $D_1 = 18$ in.; 8 in. for bottom roll;
$L = 24$ inches; $l = 18$ in. for both rolls.

$$k = \frac{(A - b) \div 2}{A} = \frac{10}{260} = 0.03846$$

The importance of factor k in the present example is slight; yet if the plate had been but ten feet wide instead of 20, k would then be $70 \div 260$ or 0.269, instead of 0.3846, and its effect in the calculation of the problem would then be considerable. While the factor k could here be entirely neglected without serious error, the formula should include the value, in order to cover all cases, especially as it is often necessary to calculate the thickness of a considerably narrower plate than the length of the rolls.

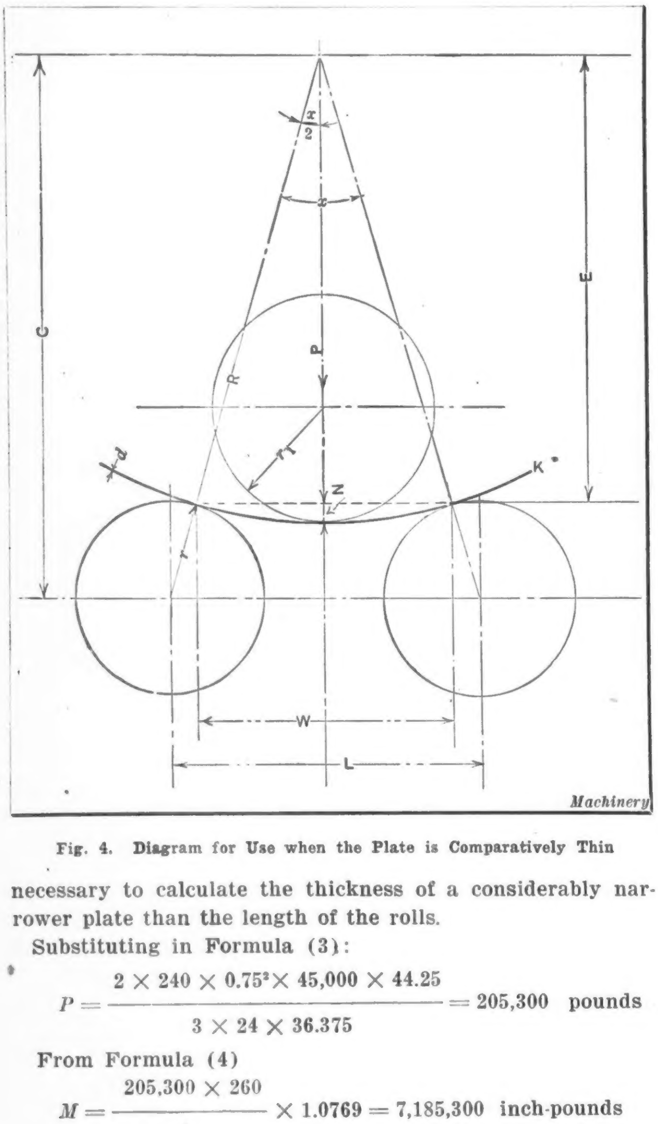


Fig. 4. Diagram for Use when the Plate is Comparatively Thin

Substituting in Formula (3):

$$P = \frac{2 \times 240 \times 0.75^2 \times 45{,}000 \times 44.25}{3 \times 24 \times 36.375} = 205{,}300 \text{ pounds}$$

From Formula (4)

$$M = \frac{205{,}300 \times 260}{8} \times 1.0769 = 7{,}185{,}300 \text{ inch-pounds}$$

$$Z = 0.0982 \times 18^3 = 572.7$$

The permissible working stress S in the top roll is

$$\frac{M}{Z} = \frac{7{,}185{,}300}{572.7} = 12{,}550 \text{ pounds per square inch}$$

This stress is a trifle too high, perhaps, but will be slightly reduced because of the necessity of enlarging the roll at the center to neutralize the deflection, as previously referred to. The effect of this enlargement will later be demonstrated in calculating this problem.

From Formula (2)

$$W = \frac{24 \times 36.375}{44.25} = 19.73 \text{ inches}$$

From Formula (13)

$$\text{Sin}\frac{x}{2} = \frac{9.865}{36.375} = 0.27120 \qquad \frac{x}{2} = 15 \text{ deg. } 44 \text{ min.}$$

$$\text{Cos}\frac{x}{2} = 0.96253$$

From Formula (6)

$$C = 44.25 \times 0.96253 = 42.6 \text{ inches}$$

From Formula (5)

$$Q = \frac{205{,}300}{2} \times \frac{44.25}{42.6} = 106{,}625 \text{ pounds}$$

From Formula (7) the bending moment for the bottom rolls is

$$M = \frac{106{,}625 \times 260}{8} \times 1.0769 = 3{,}731{,}800 \text{ pounds}$$

and

$$Z = 0.0982 \times 15^3 = 331.4$$

The safe or permissible working stress S in the bottom rolls is

$$\frac{M}{Z} = \frac{3{,}731{,}800}{331.4} = 11{,}260 \text{ pounds per square inch}$$

Application of Formulas—Deflection

From Formula (8) the deflection of the top roll is

$$f = \frac{205{,}300 \times 260^3}{384 \times 29{,}000{,}000 \times 5144 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$
$$= 0.0682 \times 4.9645 = 0.3385 \text{ inch}$$

In calculating the deflection of the top roll due to its own weight, the value of k is taken the same as when calculating the deflection due to load P. While this is not exactly correct, it is a sufficiently close approximation when the width of the plate being bent is nearly the same as the length of the body of the roll. It therefore results in the formulas for f and f_2 being composed of identical terms except those denoting, respectively, the load on the roll and its weight. The weight of the top roll is found to be 18,200 pounds and the resulting deflection is:

$$f_2 = \frac{18{,}200 \times 260^3}{384 \times 29{,}000{,}000 \times 5144 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$
$$= 0.006 \times 4.9645 = 0.030 \text{ inch}$$

The upward resultant deflection of the top roll can of course be computed in one operation, instead of two, by first subtracting the weight of the roll from the load P and using the remainder in the numerator of the fraction in Formula (8). It should be remembered, however, that if stresses and deflections are being calculated for a plate appreciably less in width than the length of the rolls, this condition does not apply, and in such cases the deflections of the top roll due to load P and to its own weight, must be computed separately.

In the present example we will assume that the bottom rolls have no roller bearing supports. The deflection of the bottom rolls due to load Q and acting in the direction OQ will then be, according to Formula (9):

$$f_1 = \frac{106{,}625 \times 260^3}{384 \times 29{,}000{,}000 \times 2481 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$
$$= 0.0735 \times 4.9645 = 0.3649 \text{ inch}$$

But for the deflection of the bottom rolls parallel to the lead P applied to the top roll, f_1 must be modified by multiplying it by the ratio of distance C to distance $(R + d + r)$, that is,

$$0.3649 \times \frac{42.6}{44.25} = 0.3513 \text{ inch}$$

The weight of one of the bottom rolls is 12,550 pounds and the resulting downward deflection is:

$$f_3 = \frac{12{,}550 \times 260^3}{384 \times 29{,}000{,}000 \times 2481 \times 0.9231} \times [5 - (24 \times 0.03846^2) + (16 \times 0.03846^4)]$$

$$= 0.0086 \times 4.9645 = 0.0429 \text{ inch}$$

The total deflection then is :

$$F = 0.3385 - 0.030 + 0.3513 + 0.429 = 0.7027 \text{ inch}$$

This deflection can be neutralized by increasing the diameter of the top roll about 0.31 inch in the center and the diameter of the bottom rolls about 0.39 inch. These two values are obtained by working the formulas for stress backward, as will be seen from the following: The new section modulus for the top roll will then be

$$Z = 0.0982 \times 18.31^3 = 602.8$$

and the safe working stress S for load P is

$$\frac{M}{Z} = 7{,}185{,}300 \div 602.8 = 11{,}919 \text{ pounds per square inch}$$

In a similar manner the stress in the bottom roll is reduced to 10,425 pounds per square inch.

Application of Formulas—Horsepower

From Formula (16)

$$E = 36.375 \times 0.96253 = 35 \text{ inches}$$

From Formula (15)

$$N = 36.375 - 35 = 1.375 \text{ inches}$$

Dividing chord W by radius $\left(R + \frac{d}{2}\right)$ to obtain the chord for a segment of one inch radius, we obtain 0.5424, the corresponding arc being 0.549 inch. Multiplying the length of this arc by radius $\left(R + \frac{d}{2}\right)$

$$y = 0.549 \times 36.375 = 19.97 \text{ inches}$$

Then from Formula (11)

$$K = \frac{205{,}300 \times 1.375}{19.97} = 14{,}136 \text{ pounds}$$

The horsepower required for bending the plate, disregarding friction, may then be found from Formula (12), thus:

$$\text{H. P.} = \frac{14{,}136 \times 10}{33{,}000} = 4.28$$

The diameters of the top and bottom roll bearings are, from the conditions of the problem, 10 and 8 inches, respectively. The power required to take care of the frictional load is calculated as follows: By proportion, the bearing speed T of the rolls is first found.

For the top roll:

$$10 : T = 18 : 10$$
$$T = 5.56 \text{ feet per minute}$$

For the bottom rolls:

$$8 : T = 15 : 10$$
$$T = 5.34 \text{ feet per minute}$$

Multiplying these speeds by the load on the respective bearings and using a suitable friction coefficient, we have

$$102{,}650 \times 5.56 \times 2 \times 0.25 = 285{,}350 \text{ (approximately)}$$
$$53{,}312 \times 5.34 \times 4 \times 0.25 = 284{,}650 \text{ (approximately)}$$

$$\text{Total} = 570{,}000 \text{ foot-pounds.}$$

The horsepower required for the frictional load is

$$\frac{570{,}000}{33{,}000} = 17.27$$

and the total horsepower with friction, but without transmission losses, is 17.27 + 4.28, or 21.55 horsepower.

The assumed roll-bearing friction coefficient (0.25) used in the foregoing calculation may seem high, but it is adopted to cover all probable conditions. In a new machine after the journals have worn to a good bearing, the friction coefficient may be much less than that here employed. However, the bearings may become badly worn or scored due to imperfect lubrication and to the destructive effect of dirt and scale that becomes loosened from the plates during bending. For these reasons a coefficient of friction of from 0.20 to 0.25 should be used in the calculation.

The bottom rolls are the driven rolls. Their circumference is 3.927 feet and their surface speed 10 feet per minute. their rotative speed then is 10 ÷ 3.927 or 2.55 revolutions per minute. If a motor is used having a speed of 500 revolutions per minute, the ratio of speeds is 500 ÷ 2.55 or 196. It will probably require four gear reductions for this ratio. The first set of three gears driving the bottom rolls may be considered as having an efficiency of 80 per cent, and the other three reductions as having an efficiency of 90 per cent for each pair of gears and their shaft bearings. The total required horsepower will then be

$$\text{H. P.} = \frac{21.55}{0.80 \times 0.90^3} = 36.9$$

Conclusion

Assumptions have been made in the foregoing calculations covering the value for S and various values for friction coefficients. The value adopted for S (45,000 pounds per square inch), is well above the elastic limit for steel usually furnished in text-books as the result of tests, but this value is generally adopted by engineers and is apparently a safe value which will cover all conditions. The values indicated for the coefficient of friction may be modified, of course, under some conditions and may very easily become somewhat higher where the conditions are unfavorable, especially in an old and badly worn machine. For this reason it is good practice to adopt a motor with somewhat greater capacity than indicated by the calculations or at least one with considerable overload capacity.

* * *

BUYING TOOL STEEL PERFORMANCE

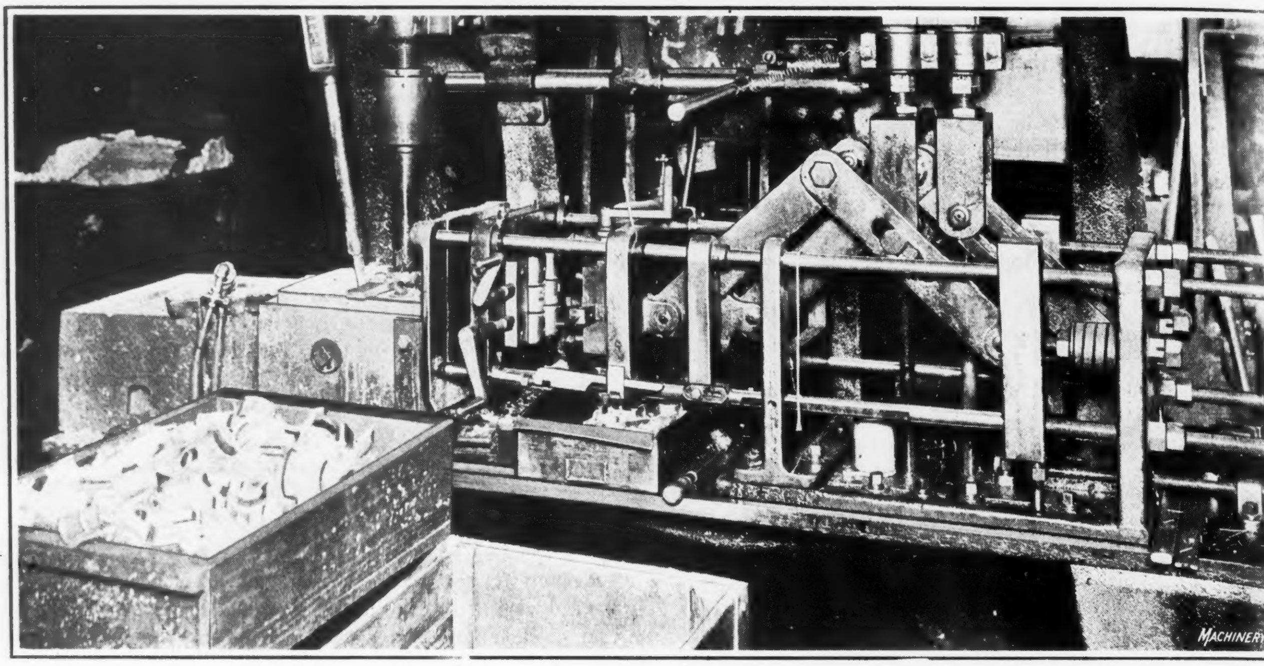
By R. POLIAKOFF

In January MACHINERY the article entitled "Buying Tool Steel Performance" states that, for the user of high-speed steel, performance and not chemical analysis is really the proper criterion. The question is left open however, of what performance requirements should be specified, and how they could be standardized.

Some time ago, the writer, recognizing the importance of performance specifications for high-speed steel versus chemical specification, undertook extensive experiments with different brands of such steel, all of European make—English, German, Austrian, Russian, and French. Special conferences were arranged both with the manufacturers' and the users' representatives, and the question of the method of manufacturing the steel was also investigated. The result was that a set of standard specifications for high-speed steel, based on performance, was finally evolved. These specifications have since been published by the writer in the Russian, German, British and American technical press, and are therefore available to those interested in the subject.

Though some revision of these specifications could, perhaps, be suggested, at the present time they are, to the best of my knowledge, the only practical attempt to solve the problem raised in the article in January MACHINERY. The writer will be glad to go further into the subject with those readers of MACHINERY who are interested in this matter.

Metals Used for Die-castings



Babbitts, Zinc-base Metals and Aluminum Alloys for Die-castings—Specifications Giving the Limits of Weight and Accuracy for Die-castings made from Different Metals

By A. G. CARMAN, Chief Metallurgist, Franklin Die-Casting Corporation, Syracuse, N. Y.

METALS suitable for die-castings must not attack the surface of the die, at the casting temperature, for this action would soon so change the form of the die depression that defective castings would be the result. It must be borne in mind that the advantage of the die-casting process is in the fact that a large number of castings can be produced from an expensive die before it has to be discarded on account of the quality of the casting produced.

The metal must have sufficient strength to withstand the strain of shrinkage from the casting temperature to the temperature at which it is removed from the die. This represents a range of from 200 to 600 degrees F., depending on the metal that is used. Shrinkage is especially noticeable in castings having large dimensions and thin sections, or in those that are formed by the use of large cores. The elongation and strength of a metal when it is cold are not always a criterion of what the same properties will be at a higher temperature. In the case of die-castings, we are particularly interested in these properties at high temperatures, for it is during this range of temperature that the shrinkage produces the strain on the metal. The strength of the metal must be sufficient to overcome the strain due to shrinkage, or a crack in the casting will be the result. In some castings where there is an opportunity for the metal to shrink without a corresponding strain, these qualities are not so important, and a metal with a greater shrinkage may be used.

The way in which the die is operated will sometimes overcome the tendency of the metal to crack in cooling. For instance, in cases where the large cores can be drawn very soon after the casting has been formed and before the metal has cooled sufficiently to cause strains, the tendency to rupture may be avoided. On the other hand, where the section is quite thick, the core cannot be drawn before the surface has become sufficiently hard to withstand the internal pressure of the molten metal, or the metal will be forced out from the interior and cause an imperfection in the casting.

The best way to determine these properties in an alloy is to actually use the metal in a die having large cores and rather thin sections. In performing this experiment, attention should be given to removing the casting from the die as rapidly as possible, for often a good casting can be made by this method, whereas working slowly and allowing it to remain longer in the die will result in a cracked casting.

General Requirements for Die-casting Metals

In connection with die-casting metals, too much cannot be said about the quality of the metal at the outset and the subsequent care prior to making the castings. In order to make good sound die-castings, it is necessary to have the metal clean, and as free from oxides, impurities, and occluded gases as possible. This means, especially with high melting point alloys, that at no time, either in the preparation of the alloy or in the heating of the metal prior to casting, should the metal become overheated or maintained at a high temperature for any length of time. At high temperature, metals rapidly absorb gases and become oxidized. When a metal has once become oxidized, it is very difficult, if not impossible, to overcome the damage done.

Surface cracks on castings, particularly where the section is thick, are often indications of porosity in the center. This porosity may be due to occluded gases, to air trapped in the metal during the casting process, or to lack of sufficient pressure to form a firm compact casting. The greater the quantity of occluded gases, which, of course, must be liberated upon solidification of the metal, the greater will be the tendency for the interior of the casting to be porous, even to the extent of not having sufficient strength to withstand the strains placed on it before it can be removed from the die.

Die-castings made under high pressure do not have a homogeneous structure, but, upon fracture, present a dense, fine-grained exterior and an interior of a coarser grain.

containing minute shrink holes where the section of the casting is thick. The fine-grained exterior is due to the pressure and to sudden cooling of the metal when it comes in contact with the inner surface of the die. This sudden cooling prevents the escape of gases occluded in the metal, and as the cooling of the casting progresses from the surface toward the interior, any shrinkage in the metal will draw from the center, leaving very small shrink holes of slightly varying size, depending upon the metal and the temperature at which it enters the die.

These shrink holes are particularly noticeable in castings having heavy sections that are made from metals with a high fusion point, and are not caused by trapping of air in the die, if precautions are taken to prevent it by properly gating and venting the die. However, small shrink holes in the interior of castings are not as detrimental as it would seem at first glance, for the exterior surface surrounding the weaker interior has a greatly increased strength, due to its dense fine grain. The treatment of the surface increases the strength, similar to the forging process.

The metals used in die-castings may be divided into three classes—the various babbitts, the zinc-base metals, and aluminum alloys.

Composition of Babbitts

Babbitt bearings made by the die-casting process are accurate in every detail. When the bearing is made in halves, oil-grooves may be included in almost any form desired. When the bearing is made as a single cylinder, oil-grooves, of course, must be straight, parallel to the central core, and opening at least at one end, preferably opposite the flanged end if the bearing is of the flanged type.

Bearings made by this process, on account of their hardened surface, are especially adapted for gas engines and machinery where the bearing metal is subjected to severe duty. There are a large number of babbitts used at present, all of which are successfully die-cast. Two babbitts used for connecting-rod bearings of motors and bearings subjected to high pressures have the following composition:

Franklin B. Babbitt

Constituents	Per Cent
Copper	4.75
Antimony	13.75
Lead, maximum	0.35
Tin	Remainder

S. A. E. No. 11 Babbitt

Constituents	Per Cent
Copper	5.75
Antimony	6.75
Lead, maximum	0.35
Tin	Remainder

Another babbitt that is used where it is not subjected to external heat and that normally runs at a low temperature has the following composition:

Constituents	Per Cent
Copper	4.25
Antimony	13.25
Lead	4.00
Tin	Remainder

A comparatively cheap babbitt that is recommended for bearings subjected to moderate pressures, has the following composition:

LIMITS TO BE OBSERVED IN DESIGNING DIE-CASTINGS

Metal	Max. Weight of Casting, Pounds	Min. Wall Thickness[1], Inches	Min. Limits on Dimensions per Inch of Diameter or Length[2], Plus or Minus	Max. Number of External Threads per Inch[3]	Min. Diameter of Holes[4], Inches	Draft[5]	
						Cores per Inch of Length and Diam.[6]	Walls per Inch
Aluminum	3	1/8	0.0025	20	3/32	0.015	0.005
Tin base	8	1/32	0.0005	34	1/32	0.0005	0.001
Lead base	10	1/32	0.001	24	1/32	0.0005	0.001
Zinc base	6	1/8	0.001	30	1/32	0.001	0.001

Machinery

[1]For small castings, the wall thickness of aluminum and zinc-base die-castings may be 1/16 inch.

[2]When the dimension involved is several inches, these limits may sometimes be reduced.

[3]When close fits are required in aluminum, the thread should be cast over-size and chased. Internal threads cannot be cast satisfactorily in aluminum, but can in some cases be cast in parts made from zinc-, tin-, or lead-base alloys.

[4]The size of hole that can be cast depends on its length and the design and thickness of the casting. Holes not cast can usually be located by spotting the casting in order to facilitate drilling.

[5]While the draft limits given in the table are desirable, they may sometimes be modified to meet special requirements.

[6]For aluminum, cores less than ¼ inch in diameter should have draft of 0.005 inch per inch of length and diameter.

S. A. E. No. 12 Babbitt

Constituents	Per Cent
Copper	3.00
Antimony	10.50
Lead	25.00
Tin	Remainder

The following is a very cheap babbitt which has been used with success when the surfaces of the bearings are large and the duty is not severe: It is not to be recommended, however, in preference to a high-tin babbitt.

S. A. E. No. 13 Babbitt

Constituents	Per Cent
Tin	5.00
Antimony	10.00
Copper, maximum	0.50
Lead	Remainder

The tin- and lead-base metals are used almost entirely for bearing purposes, but on account of the fact that they flow easily, readily filling the die, they are quite extensively used for very delicate and accurate parts. The tin-base metals, because of their resistance to corrosion are suitable for articles in which foods and drinks are contained. The selection of a babbitt adapted for a particular class of work is in the last analysis, a problem for the individual engineer. It is not uncommon to find that a babbitt that gives excellent results in one motor, for example, will fail in another, due to different conditions of service and to the different duties required of it.

Zinc-base Alloys

The zinc-base alloy that has given the best service in die-casting, according to the experience of the Franklin Die-Casting Corporation, has the following chemical composition and physical properties:

Chemical Composition

Constituents	Per Cent
Tin	7.00
Copper	3.50
Aluminum, maximum	1.25
Zinc	Remainder

Physical Properties

Melting point, degrees F.	690
Brinell hardness number	65
Tensile strength, pounds per square inch (die-cast)	23,000
Elongation in two inches, per cent	½
Specific gravity	7.17
Weight, pounds per cubic inch	0.258

Among the zinc-base alloys containing higher percentages of aluminum, used for die-casting purposes, the following has given the best results:

Constituents	Per Cent
Copper	3
Aluminum	5
Zinc	Remainder

On account of the high percentage of aluminum in this alloy, horsehead spelter, or its equivalent, should be used in order to guard against deterioration when the metal is subjected to warm, moist atmospheric conditions.

The zinc-base metal, on account of its cheapness and properties that especially adapt it for the die-casting process (such as low coefficient of expansion and greater strength, as compared with babbitt metals) is used in a

great number and variety of die-castings. When a very fine finish is required on castings made from this metal, or when it is necessary to protect the surface, it can easily be plated with nickel, copper or brass, or it can be given an oxidized finish. In some cases, these castings may be enameled, but special care must be observed in the baking process, on account of the low melting point of the alloy.

Aluminum Alloy

Aluminum die-castings are rapidly coming into general favor for classes of work where lightness, toughness, and resistance to corrosion and to severe shocks and strains are required. The alloy most commonly used, known as the No. 12 alloy of the Aluminum Co. of America, consists of 8 per cent copper and 92 per cent aluminum. It has the following physical properties:

Melting point, degrees F	1175
Brinell hardness number	60
Tensile strength, pounds per square inch (die-cast)	23,000
Elongation in two inches, per cent	1½
Specific gravity	2.86
Weight, pounds per cubic inch	0.103

This alloy presents greater difficulties during casting on account of the melting point, which is about 500 degrees F. higher than the zinc-base alloy, and on account of its corrosive action on the steel dies, especially if the metal becomes overheated or the dies become too hot. The high melting point and corrosive action of the metal makes it necessary to use the compressed-air type of machine.

Castings made from this metal weigh only 40 to 45 per cent as much as those made from the zinc-base metal. However, the price of the zinc-base metal is approximately 40 to 45 per cent of the price of the aluminum alloy, which makes the value of the metal for any particular casting the same whichever alloy is selected. The cost of casting aluminum, nevertheless, is considerably greater than that of casting the zinc-base metal. There are a number of aluminum alloys available for castings requiring a polished surface that will not tarnish readily and also for castings used for bearing purposes.

In order to maintain a high grade of metals, the virgin metals and alloys received at the plant of the Franklin Die-Casting Corporation are examined chemically to insure that the composition of the metal conforms with the required specifications. In addition to this, test bars are die-cast to determine the physical properties of the metal. This data on the various alloys is a great aid in the selection of the proper alloy for a particular casting.

There are a number of zinc-base alloys and aluminum alloys on the market for which special physical properties are claimed, but it is impossible to take up this subject at this time, for the tests on these metals have not yet been completed.

The limits given in the accompanying table should be borne in mind in designing parts for die-casting.

* * *

PROPOSED MODIFICATION OF METRIC SYSTEM

What appears to be an exceedingly unwise proposal is made in a recent number of the *Decimal Educator*, the official organ of the Decimal Association, in which it is proposed that the association concentrate its effort for the time being on obtaining an alteration of the value of the pound weight from 454 to 500 grams—that is, half a kilogram. The sixteen ounces to the pound would be retained, so that four ounces would equal 125 grams. A new ton would be adopted, which would be 2000 new pounds, which, of course, would then equal the metric ton. It seems as though we have sufficient confusion in our weights and measures as it is without proposing to add a new pound and a new ounce to those we already have. Any effort to introduce the metric system along such lines as these appears decidedly unsatisfactory.

DIE FOR ORNAMENTAL BRASS TACKS

Round-head hollow brass tacks of the type shown in Fig. 1 are produced at a high rate of speed on a Waterbury Farrel double-action power press at the plant of the U. S. Tool Co., Inc., Newark, N. J. These tacks are used for decorative purposes. The die, which is shown in Fig. 2, is of the follow type, arranged to produce two tacks at every stroke of the press. A roll feed is used, and in order to compensate for slight variations in the feeding movement an extra pair of punches is used; one of these punches pierces a hole near the edge of the strip, while the other enters the hole made on the previous stroke, and in this way locates the strip correctly in relation to the other tools.

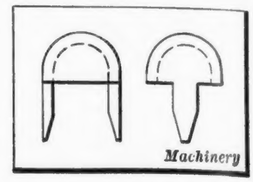


Fig. 1. Enlarged Views of Brass Tack

One pair of punches swages the points, which are approximately diamond shaped. The stock is then fed to the next position, where it is located by the means just mentioned. While in this position the swaged stock is blanked, and a drawing punch, working through each of the two blanking punches draws the tacks into the finished shape. At the same time that the blanking and drawing is taking place, another locating hole is being pierced on the margin of the strip, and the swaging punches are working at the first station of the die.

The maintaining of an accurate feeding movement is of paramount importance, because if this were not done the lengths of the prongs of the tack might be unequal, and the head would be off center. The stock from which these tacks are made is 0.020-inch brass, furnished in strips about 1 inch wide, so that the tools may be arranged to leave a minimum of scrap. The rate of production on this job is 200 tacks per minute; that is, the press operates at 100 strokes per minute.

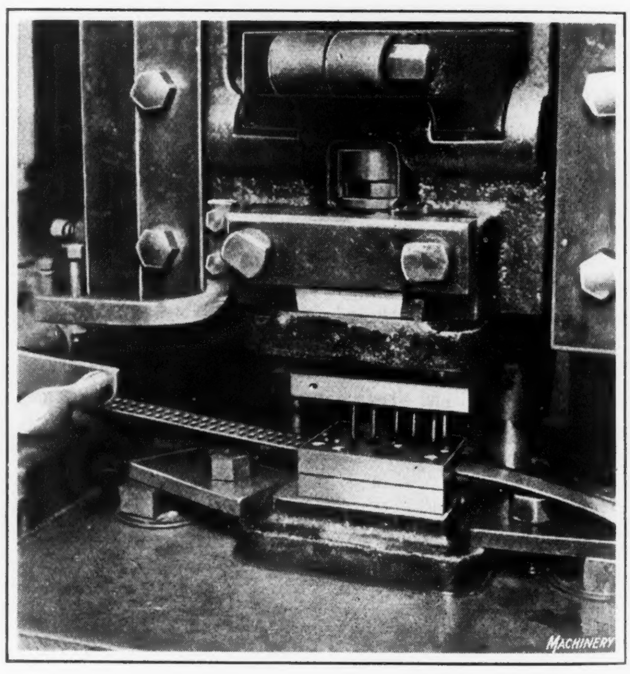
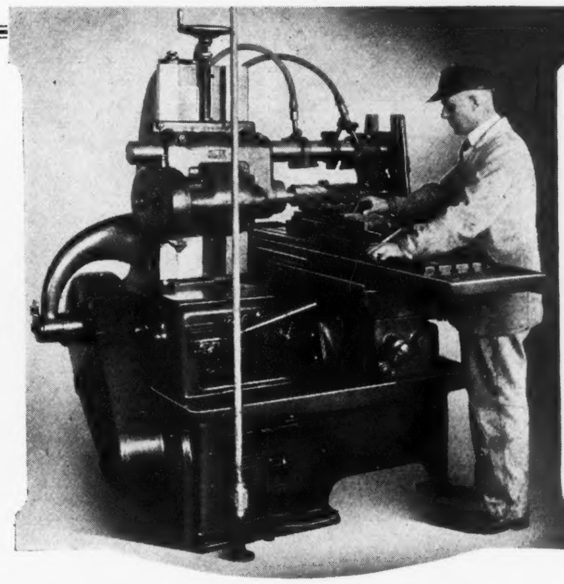


Fig. 2. Power Press with Follow-die for making Ornamental Tacks

* * *

England seems to be the only country that possesses a society of women engineers. The Women's Engineering Society is to hold its annual meeting at the Birmingham University this spring. It is stated that women engineers from Holland, France, Belgium, and the Scandinavian countries will be present, and American women engineers are also invited to be present.

New Automatic Manufacturing Type Milling Machine



A MACHINE that is designed primarily for the automatic milling of duplicate parts in large quantities has recently been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine, which is shown in Fig. 1, is known as the No. 33 automatic milling machine.

Automatic Controls

A unique feature of the machine is the automatic control of the spindle and table by means of dogs located at the rear and front of the table. The variable feed and constant fast travel, as well as the stopping of the table can be automatically controlled by properly setting the dogs. A set of dogs is also provided for automatically actuating the spindle starting, stopping, and reversing controls. The table and the spindle can be operated independently of each other. The fast and slow controls may be made to function intermittently, with the table traveling in either direction and the spindle revolving either right- or left-hand.

The spindle can be automatically stopped when the table is on its return travel, thus eliminating the possibility of marring the work by allowing the cutter to be run back over the surface machined on the forward movement of the table. The provision for reversing the spindle permits the use of two sets of cutters with teeth facing in opposite directions so that a cut can be taken on both the forward and return movements.

The constant fast travel, in combination with the slow variable feed, can be controlled automatically with the table traveling in either direction. This feature, in addition to the independent automatic control of the direction of spindle rotation, permits the automatic machining of many duplicate pieces on a production basis which would otherwise be handled by comparatively slow methods. When not equipped with a motor, the machine is driven by belt direct from the main shaft or countershaft to the single driving pulley *A*, Fig. 3. This pulley runs at a constant speed, and is mounted on the main drive shaft *A*, Fig. 4.

Inside the driving pulley is the friction clutch, operated by a lever *A*, Fig. 2, which provides for stopping and starting the machine. When the clutch lever is thrown to its extreme position, it operates a brake that stops the machine instantly. This brake also serves as a means of locking the spindle when an arbor or cutter is being removed.

On the shaft *B*, Fig. 4, which is parallel to the main drive shaft *A*, and driven from the latter by spur gears (not shown) are the friction clutches that provide for the automatic starting, stopping, and reversing of the machine spindle. The cap *G*, Fig. 3, covers one of the end bearings of shaft *B*, Fig. 4. Power is transmitted from this shaft by spur gears to a sleeve on shaft *A*. On this sleeve is mounted a silent chain sprocket.

The spindle drive through the silent chain *G*, is so arranged that a system of idlers *D*, *E*, and *F* keeps the tension on the chain constant, regardless of the height or position of the spindle. The sprocket *D* at the top of the column may be easily raised or lowered from the outside of the machine to increase or decrease the tension of the chain.

An important feature of the drive is the complete separation of the spindle-driving members from the table-feeding mechanism. This permits any combination of feeds and speeds, within the capacity of the machine, to be used. Different spindle speeds are obtained through the use of change-gears which provide for twelve changes of speed in geometrical progression, ranging from 22 to 180 revolutions per minute in either direction. The view of the machine in Fig. 2 shows the compartment *B* in the machine base where the spindle change-gears are stored. The speed available with any set of gears is shown by figures cast on the inside of the cover *D*, Fig. 3. Changes of spindle speed are effected by changing the gears on the ends of shafts *B* and *C*. The cast-iron guard *D* which encloses these gears is hinged and can be easily opened to permit changing the gears. The table feeds are positive, and are entirely independent of the spindle speeds.

There are eighteen changes of table feed ranging practically in geometrical progression from 0.38 to 24.54 inches per minute. This provides feeds ranging from 0.002 to 0.136 inch per revolution of the spindle for small milling cutters, and feeds of from 0.017 to 1.115 inch for large milling cutters. The compartment cast in the machine base for holding the table feed gears is shown at *C* in Fig. 5. This compartment is similar to that provided for the spindle change-gears. The hinged cover *A* is swung back to permit changing the table feed gears.

This machine is well adapted for motor drive. Provision is made for enclosing a constant-speed motor in a well ventilated chamber within the base. This arrangement does not increase the floor space occupied by the machine, and provides ample protection for the motor from chips and dirt. A belt with an automatic tightener is used to transmit the power to the single driving pulley, and a cast-iron guard is employed to enclose and protect these parts from injury.

Spindle Construction

The tapered end of the spindle *D*, Fig. 6, is hardened and ground, and a recess is provided in the end, as indicated at *A*, Fig. 7. The recess is also shown quite clearly in Fig. 1. This recess in the spindle nose receives the driving lugs on the arbors and collets. The latter are provided with clutches and have a threaded hole in the end of the shank. The clutch lugs fit into the recess in the end of the spindle, and the arbor or collet is drawn into place and held securely by a draw-in bolt. This bolt passes through the center of the spindle *B*, Fig. 7, and the threaded end enters the end of the shank of the arbor or collet and is

tightened by a wrench from the rear of the machine.

The silent chain G, Fig. 4, drives sprocket H, which is also shown at C, Fig. 7. It will be noted that sprocket G is keyed to a sleeve and that one of the spindle change-gears D is attached to the rear end of this sleeve. Gear D meshes with its mating change-gear E which is mounted on the short counter-shaft F. A pinion G cut on shaft F transmits motion to the gear H, which is keyed to spindle B. The hinged cover D, Fig. 3, which encloses the spindle change-gears is shown at J in the cross-sectional view, Fig. 7.

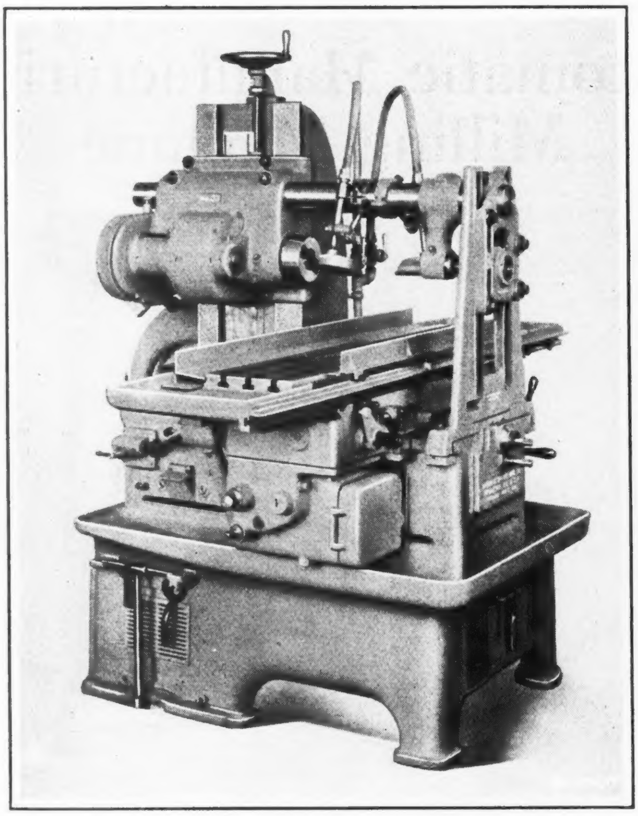


Fig. 1. New Automatic Manufacturing Type Milling Machine

Spindle Control

The lever at J, Fig. 4, and at A, Fig. 6, actuates a cam mounted on shaft C, Fig. 4, which controls the spindle starting and stopping clutch on shaft B. This lever thus controls the starting and stopping of the spindle independently of the other controls. The spindle reversing clutch which is mounted on the same shaft as the stopping and starting clutch is controlled by lever B, Fig. 6, through the medium of a cam mounted on shaft C, Fig. 4. The spindle is ordinarily started and stopped by the manipulation of lever B, Fig. 5. This lever may be automatically actuated by trip-dogs secured in slots at the front of the table. Lever B is also employed to control the table feeding movements.

Table Driving and Reversing Mechanism

Two units enclosed in separate oil-tight cases control the table movements. The first unit, which contains the table starting, stopping, and reversing mechanism, is driven by shaft K, Fig. 4. This shaft is driven by the main shaft A through spur gears. The driven gear on shaft K is held between two disks which form a friction coupling that is adjusted to permit slippage at a predetermined load. This feature eliminates the danger of damaging any important part of the machine should it become overloaded.

Shaft K may be seen at C, Fig. 2, at the point where it enters the oil-tight case of the first unit. In addition to the table stopping, starting, and reversing clutches, this unit contains a notched cam device which stops the table-feeding movement instantly when the driving clutch is disengaged. The lever D, Fig. 5, controls the clutch that stops, starts, and reverses the table feed. Levers E and F, when properly set in conjunction with dogs, such as shown at G and H, permit the table movements to be automatically controlled. The dog shown at G is used to stop the table, and the one at H, which has a longer point, is used to reverse the direction of the table travel. Levers E and F, as previously stated, are used in conjunction with these dogs.

In order to illustrate the method of employing the automatic table starting, stopping, and reversing controls, let it be assumed that it is desired to have the table feed to the right, automatically reverse, and feed to the left and stop. To obtain this movement, lever E would be left in the "up" position, as shown, and lever F would be given a half turn, so that it would point downward. Then a long pointed dog,

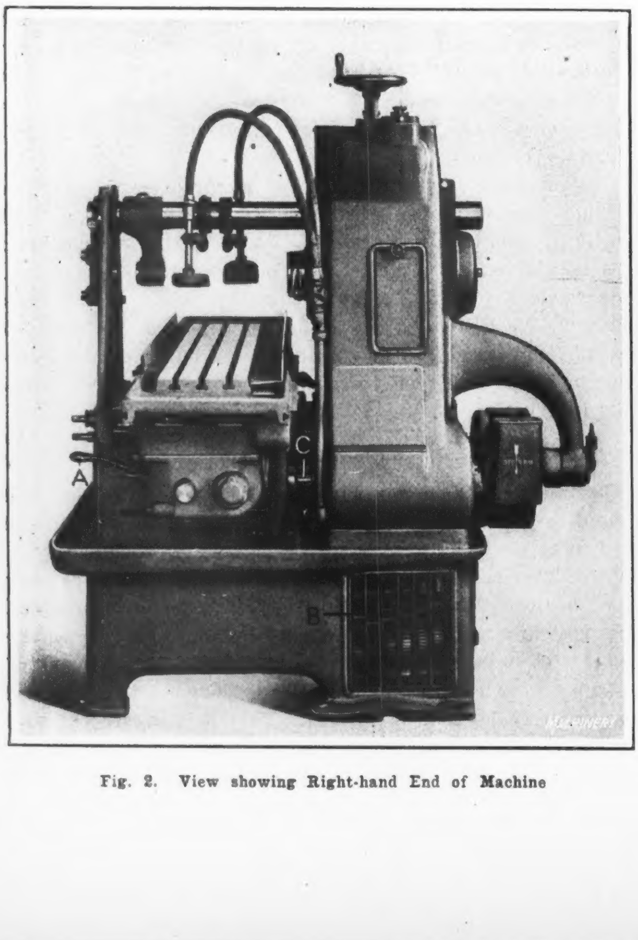


Fig. 2. View showing Right-hand End of Machine

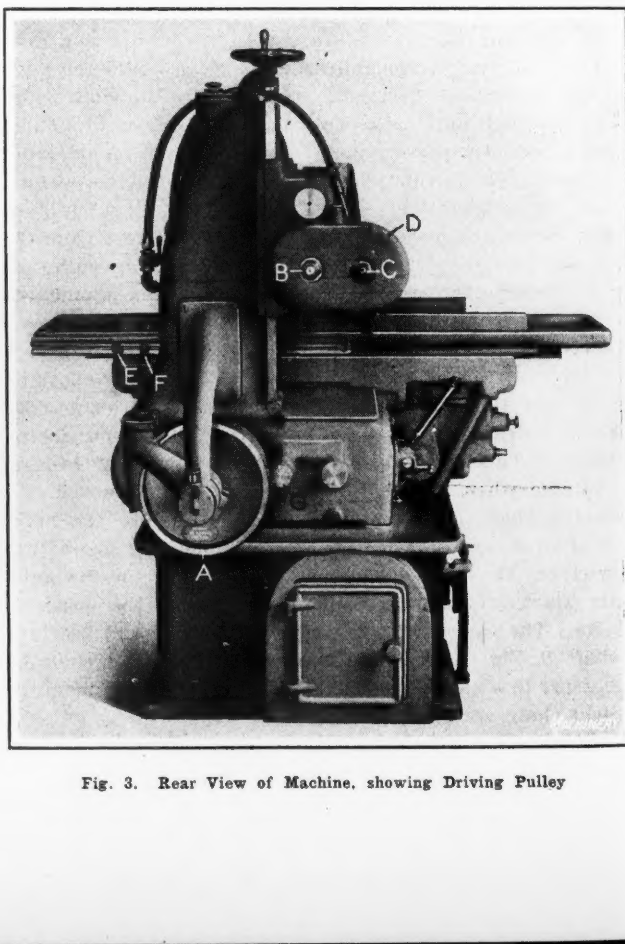


Fig. 3. Rear View of Machine, showing Driving Pulley

such as shown at H, would be placed at the left-hand side, and a short dog, such as shown at G, at the right-hand side of the plungers J and K, which must be actuated by dogs G and H in order to automatically reverse and stop the table travel.

If both levers E and F are turned to the "up" position, as shown, and a long pointed dog is attached to the table at each side of plungers J and K, the table will automatically reverse at each end of its travel. The length of the table travel is determined by the distance between the dogs. If levers E and F are both turned down and short dogs are properly set at each side of the plungers, the table will be stopped at each end of its travel. If it is desired to have the table feed to the left, reverse and then feed to the right and stop, lever E would be turned down and lever F up. In this case, a short dog would be placed at the left-hand side of plungers J and K and a long pointed dog at the right-hand side. Although the table movements can be controlled automatically by the use of dogs as described, the table may be easily controlled by the hand-operated lever D, the same as in an ordinary plain milling machine.

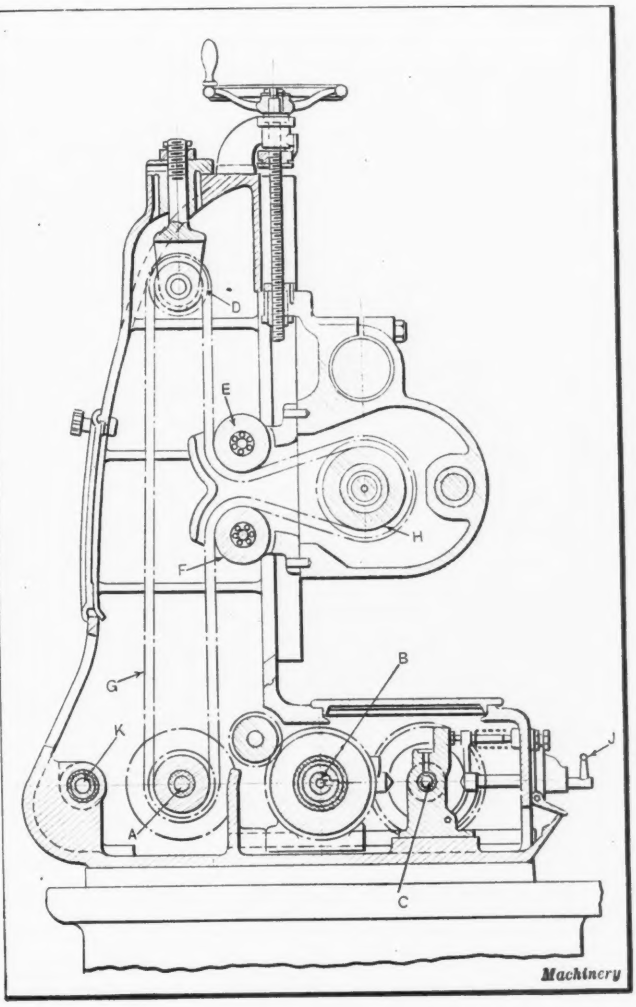


Fig. 4. Diagrammatic View, showing Method of driving Spindle by a Silent Chain

Feed Varying Mechanism

The table feed-varying mechanism is enclosed in an oil-tight case, and is driven from the starting, stopping, and reversing unit through a universal joint connection. The feed-varying mechanism is a complete unit in itself, which, when actuated by means of dogs such as shown at L and M, Fig. 5, permits the table to be automatically given a fast or a slow feed as desired. The table feed change-gears previously referred to are used with this unit to obtain the desired rate of feed. By pulling the small button N outward the power drive can be disconnected so that the table may be fed by hand.

Lever B controls the fast and slow feed, and, in addition, actuates the spindle stopping and starting clutches. All the automatic operations of the machine are controlled by means of the adjustable table dogs. Four different styles of dogs are necessary if every automatic control available is to be employed. However, for ordinary milling operations only two or three of these styles are needed. Dogs such as shown at E and F, Fig. 3, at the back of the table, control the reversing of the spindle.

A trip-dog such as shown at P, Fig. 5, designed to act on the pivot gear sector Q engages the table slow-feed clutch. The same dog also starts the spindle automatically when the slow feed begins. The long dog L can be set to operate, when the table is moving in either direction, for the purpose of engaging the fast feed mechanism. The table moves at a constant fast rate of travel when reversed, and the spindle

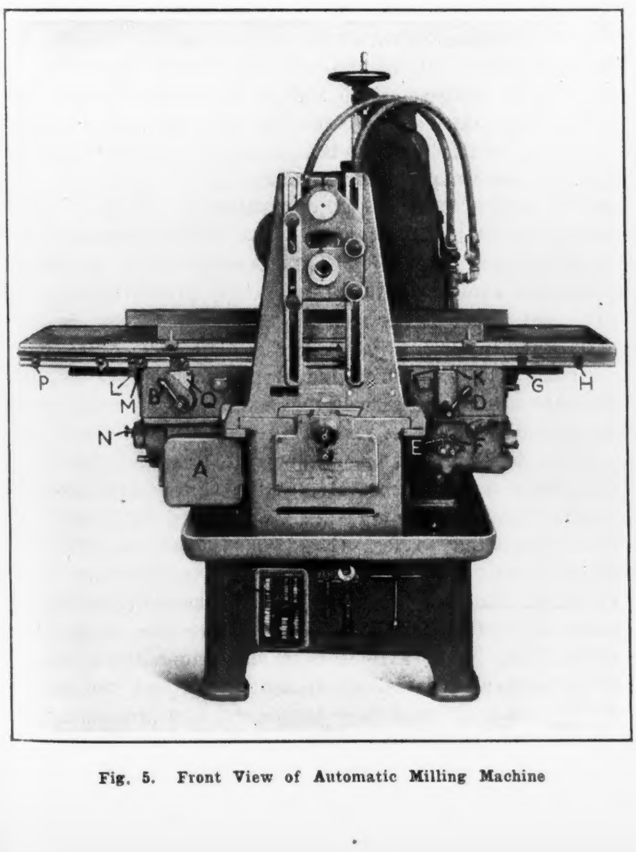


Fig. 5. Front View of Automatic Milling Machine

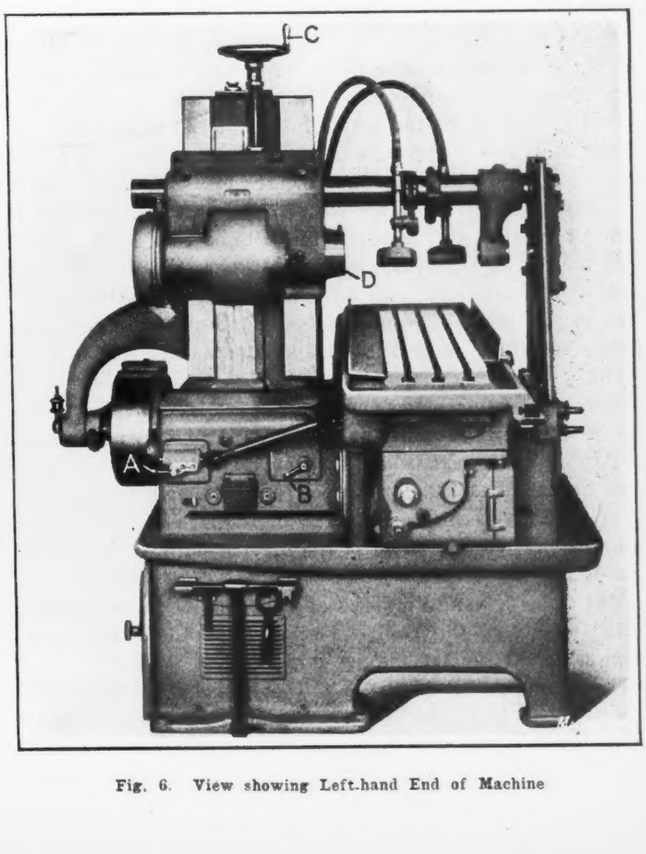


Fig. 6. View showing Left-hand End of Machine

is automatically stopped when the table is reversed or stopped, and started again only when the slow feed is engaged. Of course, lever *B* can be operated by hand instead of by the table dogs, if desired. When this lever is moved to the left-hand position, as shown, the slow table feed is engaged. A movement to the right serves to engage the fast table feed, and a still further movement in a right-hand direction serves to stop the spindle.

General Construction

The limited amount of space available prevents a full description of the table feeding and controlling mechanisms. These units are designed to withstand the hard usage to which a manufacturing type of machine is generally subjected. Ample strength and rigid construction have been secured by the use of box construction. The internal bracing of heavy webs throughout the frame makes the machine very strong and rigid.

The main drive shaft runs on ball bearings, and is supported on both sides of the driving pulley. The arbor is exceptionally well supported by an adjustable overhanging solid steel arm. An arbor yoke, employed for supporting the arbor at any intermediate point near the cutter, furnishes added support for heavy work. The wearing surfaces of the table and all bearings throughout the machine are of ample proportions. Provision for adjustment for wear is made throughout The complete enclosing of all working parts and the convenient arrangement of all controls at the front tends to develop a high degree of efficiency in operation.

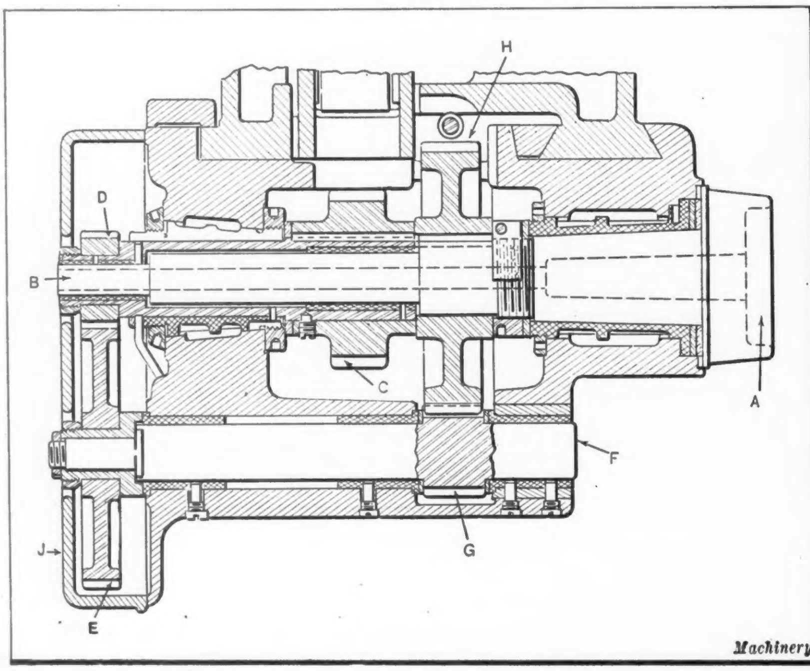


Fig. 7. Sectional View of Spindle

The automatic lubrication of all rotating parts within the frame of the machine is an important feature. The oil-tight cases contain reservoirs into which the rotating members dip, thus supplying ample lubricant for themselves and at the same time carrying the oil up to tubes running to the bearings. Rolls that dip into oil reservoirs keep a film of oil constantly on the table ways. The cutting lubricant is pumped to the work from a large tank cast in the base. Two nozzles are provided so that if two cutters are used, each will be provided with an ample supply of cutting lubricant at all times. Provision is made for cutting off the supply to either or both of the nozzles as desired.

The machine has an automatic longitudinal feed of 34 inches, and a transverse adjustment of 5¼ inches. The spindle can be adjusted vertically by means of the handwheel shown at *C*, Fig. 6, through a distance of 15 inches. The spindle nose has a No. 11 B. & S. taper, and the hole through the spindle which accommodates the draw-in rod is 13/16 inch in diameter. The diameter of the driving pulley is 14 inches, and it carries a belt 4½ inches wide. This pulley is intended to be driven at a speed of 350 revolutions per minute. With this speed the twelve available spindle speeds range from 22 to 180 revolutions per minute.

The diameter of the hole in the bronze bushing of the arbor support is 2 1/16 inches. The distance from the center of the spindle to the under side of the over-arm is 5½ inches. The greatest distance from the end of the spindle to the center in the arbor yoke without arm braces is 27 inches. The maximum distance from the end of the spindle to the bushing in the arm braces is 19¾ inches, and from the spindle head to the arm braces, 24 inches.

The working surface of the table is 52 by 12½ inches, and the over-all dimensions, 74 by 17¼ inches. There are three ⅝-inch T-slots in the table. The eighteen changes of feed range from 0.38 to 24.54 inches per minute. The fast travel between cuts is 210 inches per minute. The capacity of the cutter lubricant tank, which is cast in the base of the machine, is 42 gallons. The machine weighs about 6200 pounds, and requires a floor space of approximately 108 by 69 inches.

* * *

EXPORTS BEFORE AND AFTER THE WAR

In an article published in *Commerce Reports*, by W. H. Rastall, chief of the Industrial Machinery Division of the Department of Commerce, statistics are given covering the exports of industrial machinery from the United States in 1921 to thirty different countries. From the figures given it will be seen that in the year 1921 Mexico imported American industrial machinery to a greater value than any other country, Canada coming second, Cuba third, Japan fourth, and China fifth. Among other big customers of the United States are the United Kingdom, France, British India, Brazil, and Argentina, in the order named. The table also shows a comparison with the exports of industrial machinery before the war, and it is interesting to note that there has been a considerable realignment of our foreign markets. Canada, however, has always been a leading customer for industrial machinery, holding the first place in 1913; but in that year the United Kingdom came second, and Germany third as buyers. In 1921 Germany was the thirty-first country on the list in respect to the value of industrial machinery imported from the United States. Altogether, $246,400,000 worth of industrial machinery was exported in 1921, as compared with $320,000,000 in 1919, and $384,000,000 in 1920. Latin America took a greater share of our exports in 1921 than in any preceding year. In 1910 it took about 30 per cent; in 1913, 23 per cent; in 1919, 19 per cent; in 1920, 27 per cent; and in 1921, over 37 per cent of the total exports in industrial machinery.

The tabulation appearing in *Commerce Reports* for January 22 is of great interest as indicating what countries are most active in developing along industrial lines at this time. It also indicates the great strides that have been taken in exporting machinery in the last decade. In 1910, the total exports amounted to less than $52,000,000. In 1921, the value was over $246,000,000, or nearly five times as much. Even when allowance is made for increases in prices, the exports in 1921 were fully double, by volume, what they were in 1910; and 1921—it must be remembered—was a year of business depression. Hence the outlook for the exports of industrial machinery in general is a promising one, great strides having been made in a comparatively brief period.

The British Metal-working Industries

From Machinery's Special Correspondent

London, February 13

THERE are many signs of a better state of things all around in the metal-working industries, and remarkable strides have been made toward normal trade conditions since the beginning of the new year. With the exception of the Clyde district, there has been a constant fall in the number of unemployed.

Conditions in the Machine Tool Industry

In the machine tool trade in both the Birmingham and Manchester districts there is a vivid contrast with the conditions of even a month ago. Several firms that were visited were noted to be working at their full normal capacity. This is particularly true of firms engaged in the manufacture of tools for general purposes. Makers of heavy machine tools are also fairly busy, and plants devoted to highly specialized lines are beginning to take on more men.

Demand is not confined to machines of any particular type. In fact, it is very general. For example, one of the largest machine tool makers in the West Riding of Yorkshire is reported to have taken orders during December for lathes, planers, and boring mills to the value of over £40,000 and during the second week in January obtained additional business to the value of about £12,000. Another firm in the same district is fully occupied in the production of radial drilling machines. Grinding machine makers report an improved demand, and a large amount of special work is being done for textile machinery makers. A well-known firm specializing in the production of machinery for twist drill making is taking on more men, and besides home orders, is engaged on a number of orders for overseas. Scottish machine tool makers report a slight improvement.

Generally speaking, fully 50 per cent of the work at present in hand is for overseas destinations, the railway shops of India being by far the largest individual buyers. Home trade is divided. That textile machine makers are taking a fair number of special machines has already been mentioned. Railway shops are also coming to the fore, and orders are at present being handled on their account, particularly for boring mills, lathes, and so on, as used in the manufacture of railway wheels, axles and tires.

Curiously, despite the prevailing conditions in the shipbuilding industry, a quantity of tools for use in the shipyards are now being built. The electrical trades are mainly interested in heavy machine tools, and quite a large proportion of the bigger machines now in the shops are for use on large turbine, turbo-generator and similar heavy electrical engineering work.

Makers of Diesel engines, both for land and marine purposes, are also taking an active interest in machine tools, and in view of the developments in this particular field, there is likely to be a demand for certain classes of machines in this specific direction. Engines of this type are particularly well adapted to modern manufacturing methods, and the grinding process, especially for finishing the internal surfaces of the engine cylinders, is attracting considerable attention.

In the fields related to the machine tool industry there are signs of greater activity. A fair amount of special jig work has recently been placed. Small tool, twist drill, and hacksaw makers are also active, and are busier than they have been for a long time. Makers of files experience a greater demand and also ruinous under-selling. As a measure to check this, many makers have agreed to minimum prices below which none of them will quote.

Overseas Trade in Machine Tools

It is now possible to compare the total exports and imports of machine tools in 1922 with 1921 and other years. The value of the machine tools exported during 1922 was only a little over half that of 1921, the actual figures being £1,530,800 and £2,920,500, respectively. The tonnage was 12,160 in 1922 as against 20,064 in 1921. Thus it will be seen that the value per ton of the total exports during 1922 fell from £145 (the average for 1921) to £126. The pre-war average over three years (1911-1914) was £61 per ton.

Imports also fell off heavily during 1922, although the total tonnage was increased. The total imports amounted to £423,500 as against £632,200 in 1921, the corresponding tonnage being 3385 and 3000. This increase of tonnage, despite the great drop in value, is accounted for by the heavy fall in the value per ton which averaged £210 in 1921 and only £125 last year. The last figure compares favorably with the pre-war average of £97 per ton.

It is interesting to compare the overseas trade in machine tools with the total trade of the country during the three years 1920, 1921 and 1922. If the total export trade in 1920 be taken as 100, the figures for the three years stated would be 100, 52, and 54. The machine tool exports for the same three years, letting 100 represent the exports for 1920, would be 100, 85 and 44. These figures show that the trade in machine tools more than maintained its position during 1921, but during 1922 fell considerably. These figures are based on total values only.

For the last month of the year the returns showed a further fall from the figures reached in October, the value of exported machine tools being £112,090 for 955 tons, giving a value per ton of £117. Imports rose from £26,820 in November to £36,833 in December, the value per ton also rising from £134 to £141. In December, lathes and the simpler heavy machine tools formed the greater part of the exports, totaling over 600 tons. The largest class in imports was drilling machines, which totaled 61 tons, lathes coming next with 45 tons. It is interesting to note that drilling machines and presses are the only items on which the value per ton of exports exceeds the value per ton of imports. For drilling machines, the value is almost 45 per cent higher, while presses are 25 per cent higher. On the other hand, imported grinding machines show a value per ton about 60 per cent higher than exported machines.

Iron and Steel and General Engineering Fields

In the general engineering and iron and steel fields, there is a decided improvement. Pumping machinery makers are finding conditions brighter, with some opening out of foreign business. Engine builders are moderately well off, but the textile machinery makers are better situated than any other branch of the engineering industry. There is also a considerable demand for rolling stock.

The iron and steel trade is on the up grade, and each week marks the re-opening of works and iron-ore mines that have been closed for two years. Today practically all Continental works are uncertain as to deliveries and prices, so that home makers are in an advantageous position for the time being. Foundries are relatively active, and there is an exceptionally good demand for pig iron.

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STANDARDIZATION'S ACTUAL RESULTS

The United States Chamber of Commerce estimates that the aggregate cost of production in the manufacturing industries could be reduced fully 25 per cent if unnecessary models, types and sizes were eliminated. This statement is not a guess, but is based upon statistics furnished by industries in which cooperative effort has made standardization and simplification possible. The Chamber of Commerce gives specific figures to show what standardization has accomplished by eliminating unnecessary sizes or types, a few of which are mentioned below.

Before an effort was made to standardize pipe fittings, there were 17,000 different styles, types and sizes made. Now this number has been reduced to 610. Car wheels have been reduced from 175 types and sizes to 4. Malleable chain has been reduced from 2044 to 820; dry cells, from 17 to 6; hammers and axes, from 2752 to 761; shafting, from 69 to 14; steel lockers for factory equipment, from 37 to 9.

An important work has been begun, and it must not be suspended until every possibility for standardization has been tried out in all manufacturing fields. Wherever economies can be effected, standardization is of the greatest importance to American manufacturers, because many of the European countries, particularly England and Germany, are working with a definite purpose along this line; and when the world again returns to an economic equilibrium, our manufacturers should be ready for the world's markets with products economically manufactured under systems of standardization as nearly complete as possible. We are a long way from perfection now.

* * *

BUILDING SPECIAL MACHINERY

Many manufacturers employing special machinery for an unusual operation or process still believe they can save money by developing such machines in their own shops instead of employing a machine tool builder or a shop that specializes in that kind of work. As a rule, the manufacturer who employs his own designers to develop special machine tools finds the cost considerably greater than if he had employed a specialist; and it is seldom that the results are as satisfactory as when the work is done by an experienced machine tool builder.

In one instance a builder of heavy machinery figured on saving money by developing in his own shop a machine of a type offered by a special machinery builder. His designers were occupied for five months without producing a satisfactory machine and finally an order was placed with the machine tool builder requesting that the machine be delivered within one week.

Users of special machine tools do not always have a clear conception of the cost of developing machines of unusual types, and often compare the price of a special machine, of which only one or a few are built, with that of a standard machine tool of which several hundred or thousand are manufactured. A well-known machine tool builder some time ago refused to build a special machine for less than $30,000; and as this figure was considered exorbitant by the prospective customer—an automobile manufacturer—the latter proceeded to develop the machine in his own shop. After two years spent in experimenting, scrapping and rebuilding, a satisfactory machine was developed at a cost of over $50,000. There are exceptions to the rule, for various reasons; but, generally, a shop organization experienced in handling such work can build special machinery better, more promptly and cheaper than can the user himself.

* * *

ADEQUATE SHAFT SUPPORTS

A fault frequently overlooked in power transmission installations is the overhanging shaft. When the end of a shaft projects beyond its bearing, both the bearing and the shaft are subject to unnecessary wear. The greater the length of the overhanging section, the more rapid the wear. The uneven wear to which the teeth of pinions and gears mounted on such a shaft are subject, is often the cause of noisy gearing, early replacements and needless expense.

The necessity for replacing gears, shafts and bearings is too frequently accepted as a matter of course, and an investigation into the causes underlying the need for frequent repairs will often reveal conditions that can be easily remedied. A few comparatively inexpensive changes or additions to the equipment may effect a worth-while saving in the annual expense for replacements and repairs.

The obvious remedy for an overhanging shaft is the addition of a bearing to support the overhanging end. Additional supporting bearings for long lead- or feed-screws, when possible, increase accuracy and eliminate needless wear on the screw thread. If a long lead-screw is not properly supported, the thread will wear unevenly. The pressure exerted by the nut in taking up the sag will be greatest at the point of maximum sag, and the thread at this point will wear more rapidly than at the ends near the supports.

Attention to the repair and upkeep of shop equipment is as important as the design or installation of new machinery.

* * *

BETTER EQUIPMENT FOR SMALL RAILROAD SHOPS

It is the practice of some railroads to transfer obsolete machine tools from the main shops to the smaller repair shops, evidently because it is believed to be economical to use, in the smaller shops, machines no longer considered adequate where a larger volume of work is done; but the fact remains that an inferior machine is inefficient wherever used. While small shops do not need as large a variety of tool equipment, they do require modern designs and types, since the function of railroad shops, regardless of size, is to keep locomotives in service and to reduce the idle repair periods to a minimum.

Even at the present time, machines of the lighter designs, antedating the introduction of high-speed steel, are found in many railway repair shops, especially in the smaller and less important ones. It is not uncommon to find lathes, planers, and other machines which have been used for twenty years, and some are considered worth shop-room even after forty years of service. Needless waste results from the use of such inadequate equipment. The relatively light cuts and slow speeds greatly decrease production, and errors often caused by such inefficient and inaccurate tools increase the time required for assembling machined parts. Antiquated designs are always discouraging to the men who must them—a factor of considerable importance, but one frequently overlooked. Well constructed machines inspire confidence and promote the production of more and better work.

The Need for Mechanical Training

MANUFACTURERS in the machinery field find that although their shops are operating on what is still only a comparatively light schedule, skilled mechanics are scarce. We have just passed through a period of widespread depression and consequent unemployment, yet complaints are already heard from many sources that it is hard to find skilled workmen in the machine shop field.

What is the reason? Isn't it that we have neglected to train the men the industry needs and must have? Where are the skilled men to replace those trained years ago, who are now passing out of the ranks? The machine tool industry, especially, needs a high grade of skilled labor. It needs men of all-around training for foremen and superintendents. It needs salesmen with thorough mechanical experience—the best type of machine tool salesman is the man who knows machine shop work from the ground up. Is there any problem of greater importance before this basic industry?

What is the best method of developing the supply of all-around mechanics? So far nothing that has been proposed is quite equal to the appenticeship method. Doubtless modifications should be made in the old type apprentice training to meet modern conditions, but it is beyond question that the industry must depend chiefly upon, and will profit most from, the training of an adequate number of apprentices.

Training for Responsibility in the Mechanical Field

It may seem more profitable to a manufacturer to train a young man in lathe work only—to make him a lathe department foreman perhaps; or in milling machine work, and put him in charge of the milling department. With this limited experience he is more likely to remain in the shop, and his training is comparatively inexpensive. But men of broad experience make the best foremen, and skilled men are needed for assemblers, erectors, toolmakers, service men and repairmen. They all require a much broader training than a single department of a shop can give, and without such men the machine industries are seriously handicapped.

To train these men adequately, a regular apprenticeship is needed. Four years is none too long for a boy to learn the trade thoroughly, and he should be given opportunity and incentive to acquire experience in every line of work in the shop. The apprentice cannot learn too much, and he should be guided and assisted in studying the trade literature of his chosen life-work.

Furthermore, provision should be made for the training of young men who have had more than an ordinary public school education. Some of the large corporations, like Westinghouse and General Electric, realize this. They have apprenticeship courses suited to boys from the grammar school, from the high school, and from college. It is particularly important to provide for the college man shorter courses than the regular apprenticeship term so that he can get a thoroughly practical training in a comparatively short time. Manufacturers must realize the importance of looking ahead. The machine-building industries must prepare to train the leaders that will be needed ten and twenty years from now.

Objection is frequently made that many apprentices, after completing their training, leave the shop that has spent time and money to train them, but this is only the natural thing for a young man to do. He wants to broaden his experience, and the manufacturer who loses one of his own apprentices in this manner is as likely to hire a skilled man who has been trained elsewhere. It amounts to a fair exchange, and generally speaking, the mechanic who has been in more than one shop is a better man for the industry. There is no loss anywhere; on the contrary, the industry as a whole gains by having a greater number of trained men available.

To place the system on a square and equitable basis, every shop belonging to one of the national trade associations that promote the systematic training of apprentices should be required to graduate annually a certain number, according to the size of the shop. When this is done, there will be no scarcity of skilled mechanics in the future. And until it is done, the industry is eating its cake and trying to have it too.

Progress and prosperity in the machine tool industry will depend very largely upon the number of skilled men available now and in the immediate future. This industry demands the service of high-grade skilled men more than any other branch of the metal-working industries, and has unequalled standards to maintain. There must be thoroughly established apprenticeships, and they must be made attractive enough and broad enough to tempt unusually intelligent and ambitious boys and young men to enter the trade. The last period of prosperity in this country showed clearly the great opportunities for men well trained in the industry.

It is especially the shop training that must be taken care of by the manufacturers. The training that the ambitious young man, willing to fit himself for greater responsibilities in the future, can obtain for himself by studying books and periodicals is well taken care of by the literature on shop and drafting-room practice that is available to any young man who wishes to devote some of his spare time to study.

There is no other way in which a sufficient number of young men can receive a satisfactory training than by a carefully planned apprentice system. Each manufacturer must be willing to do his share. It will cost something to train apprentices, but the industry will be amply repaid for this expenditure. The supremacy of the American machine-building industry depends upon it.

Industrial Conditions in Southeastern Europe

By OSCAR ERICSSON, Copenhagen, Denmark

In this article, the author, who for many years has sold machine tools in different parts of Europe, and who at present represents several well-known American machine tool builders there, records his impressions from an extended journey in southeastern Europe, during which he visited Poland, Czechoslovakia, Austria, Hungary, Jugoslavia, Bulgaria, and Roumania. As comparatively little is known in the United States of the present industrial conditions in these countries, this brief review will undoubtedly prove of interest to American manufacturers.

TRAVELING in the southeastern part of Europe is not very pleasant, and the inexperienced traveler is warned against undertaking a journey there. Both train accommodations and hotels are unsatisfactory. In the hotels and railroad cars, cleanliness is lacking, and the traveler is certain to have many unpleasant experiences. At every border—the writer crossed nine of them—the visitor spends three hours, on an average, in having himself, his passport, his money, and his baggage examined. In every city and town he must report in person, upon arrival and departure, to the authorities, and each time a certain amount must be paid for stamp fees.

It seems as if pains were taken to make traveling as expensive and difficult as possible. The short-sighted policies of those in power in these countries is beyond comprehension. It is no wonder that their industrial and financial status is what it is. The different nationalities that make up the new southeastern Europe all seem to hate each other, and to do everything in their power to injure one another by trade regulations and obstructive laws. They do not seem to realize that in this way they are injuring themselves as much, or more.

During my travels I was assisted to a great extent by the commercial departments of the American Consulates, and I think it is only fair to say here that probably no foreign consulates are doing as much, either for their citizens or for those who represent the business interests of their citizens, as the American Consular Service. I have had occasion during my many years of travel for business purposes to come in contact with the consular services of various nations, and I believe that this word of appreciation should be recorded.

From a business point of view, however, I found that the southeastern European countries were almost entirely neglected by American concerns, while the countries were literally swamped by the business agents and traveling representatives of English and German manufacturers. As to languages used by a commercial man traveling in these countries, German is the only generally understood language except in Roumania where French is also used.

Industrial Conditions in Austria

Austria is in great need of new machine shop equipment. The production machinery of the Austrian shops was subjected to severe service during the war, and much of it needs to be replaced. But at present it is practically impossible to sell American machines in this country on account of the abnormal exchange rate. As an example, I might mention that the 3½-inch by 5-foot Lo-swing lathe would cost about 120,000,000 Austrian crowns, delivered in Vienna.

Previous to the war, practically all the machine tool business of Austria was handled from Vienna, except the part that was handled from and through Germany—quite a large proportion. The splitting up of the Austrian Empire into many separate states has naturally made Vienna less of a trading center than it was in former years. At present it would be inadvisable to let an Austrian, or even a German, firm take charge of American interests in any of the new countries formed by the disintegration of the Austrian Empire, because there is a great deal of jealousy between different countries.

Czechoslovakia

Seventy per cent of the industries of the former Austrian Empire are located within the borders of the Czechoslovakian Republic. More than half of the country's industries are under the management of German or Austrian Czechs. The manufacturers in Czechoslovakia are thoroughly alive to the need for improved machine shop equipment, and give a great deal of attention to modern methods, but the financial situation here, as well as elsewhere, stands in the way of any business in the immediate future. While the Czechoslovakian money has improved in value to such an extent that the exchange rate is 100 per cent more favorable now than eight months ago, this is not an unmixed advantage. There is considerable unrest in industrial circles, because an improved exchange rate means greater difficulty in the export trade, and in Czechoslovakia the export business is the important matter; the country is in possession of most of the raw materials needed for manufacturing within its own borders. The improved exchange gives the country the ability to buy from abroad, but prevents it from selling, which appears to be exactly the opposite condition for best meeting the present needs of that country. As a result, while this nation would be capable of buying, fear for its future export markets prevents any industrial expansion at the present time.

Hungary and Jugoslavia

Hungary is greatly handicapped by having been deprived of a large territory which formerly supplied the country with coal, iron, and lumber. With the exception of Austria, Hungary seems to be in the worst condition of any of the countries in southeastern Europe. In the railroad shops, in one of the large electrical factories, and in one of the largest general machine-building plants in the country, I found definite need for modern machine tools. But Austria and Hungary are less able to buy than the other countries visited.

Jugoslavia presents a more favorable condition. Before the war, Austrian influence no doubt prevented proper industrial developments in this part of the former empire, and it was devoted almost entirely to agricultural pursuits. Since the war, efforts have been made to develop industries within the country. It is also surprising to note the great number of modern buildings that are being erected in Belgrade, in an effort to give that city a more European appearance.

The national debt of the country is comparatively small, and the natural resources comparatively great. For example, the oak forests of Jugoslavia are the greatest in Europe;

and in intensive agriculture the country is rated as the second in Europe, Denmark coming first. Hence, this country has good prospects of developing into a prosperous nation, provided steps are taken to utilize fully its natural resources. The English realize this, and British firms are busy building railroads and bridges here. At least one well-known British firm is also planning to build a branch factory in Belgrade. It may be of interest to American machine tool builders to know that Ingenieur R. Nikolitsh, Verkehrsministerium, Koenig Petersstrasse 41, Belgrade; is in charge of all the equipment for the Jugoslavian State Railways.

Bulgaria and Roumania

There are practically no industries in Bulgaria and there is little or no demand for machine shop equipment at present, except for the state railway shops. A complicated course must be followed in doing business with the Bulgarian Government. The Government requires that the foreign seller maintain a representative in Bulgaria, and furthermore requires with each bid (1) a certificate from the Department of Commerce in the country of origin that the firm making the bid is in good standing and is actually a producer of the goods offered; (2) assurance that the firm making the bid has delivered similar goods elsewhere; (3) a certificate from the Department of Commerce covering the appointment of a representative for this particular transaction, or for business transactions in Bulgaria in general; (4) a deposit, which is usually 5 per cent of the total amount of the bid, or a 1 per cent deposit with the bid, and a guarantee by the Bulgarian National Bank that the other 4 per cent will be paid ten days after the order has been placed.

In turn, the Government usually pays one-third the value of the order upon a guarantee from the bank that the goods will be delivered; one-third against the bill of lading, sent through the bank, and the remainder after the final inspection of the goods. The financial transaction must pass through the seller's bank to the Bulgarian National Bank, where the seller must open a guarantee account in order to obtain the necessary deposit certificates to satisfy the Bulgarian Government.

American manufacturers should not send catalogues to Bulgaria by parcels post, as they are subject to a heavy duty. All catalogues should be sent as printed matter.

In Roumania practically all the industries are controlled by banking interests, except the shops belonging to the state railways. Since the territorial expansion of Roumania, important plans have been made for the expansion of the state railway system, which will involve the building of bridges, adding considerable mileage of track, and the building of new shops. The present rolling stock and permanent way of the Roumanian state railways is in a very bad condition, and there were not less than eighteen accidents in the month of October, three of them occurring at the same spot.

The Baldwin Locomotive Works maintain a large office in Bucharest, and have delivered many locomotives to the Roumanian railways. The address of the state railways administration is Le Direction de la Chemin de Fer de Roumania, Bucharest.

Poland

The greatest activity in Poland is in connection with railway development and the building of rolling stock. The chief of the machine equipment of the Polish state railways is Inz. Zygmunt Peszkowski, Nowy Swiat 14, Warsaw. The Polish Government has ordered 7800 passenger cars, and 70,000 freight cars from Polish firms, to be delivered over a period of years. In addition to these cars, the Government has ordered 2970 locomotives from Polish firms, one-half of this number being ordered from H. Cegilsky & Co., Posen.

Several of the firms that have received orders for locomotives and cars have negotiated with American firms for machine tool equipment. The great difficulty in selling to these firms is that they all want credit covering several years. One firm alone has bought from Sweden machinery valued at 1,000,000 kronor ($270,000), the payment for which is guaranteed by the Polish Government. But in general it is not possible to obtain a guarantee for equipment bought abroad, the Government taking the stand that the order it has placed with the Polish manufacturers with stipulated payments on given dates should be a sufficient guarantee for the foreign seller of machines.

When goods are to be sold to Poland, some information should be obtained in regard to the commercial law governing the part of the country to which the goods are sold because in those parts of Poland that formerly belonged to Germany and Austria, the laws do not yet agree with the Polish law governing the rest of the country. It is therefore advisable to obtain definite legal information from the American Consulate or from a law firm recommended by the consulate in that part of Poland to which the goods are to be sent.

All the firms that have obtained orders from the Polish Government for locomotives and cars are in great need of modern machine tools. At present most of these needs are met by German manufacturers, who are said to extend credit to the Polish buyers. The Polish firms ask that their payments be extended over a period of eight years, which is evidently an impossibility for any machine tool builder to grant. The Polish Government, when approached with regard to the buying of machine tools that their engineers state they prefer, wanted credit extended over a period of ten years! There is no duty in Poland on machinery of any kind if it is not manufactured in the country; and as there are practically no machine tools built in Poland, this means that machine tools are free of duty. But this does not help much when the finances of both public and private enterprises are such that they are unable to pay for their purchases except on an installment plan extending over a period of from eight to ten years.

Possible Market for Machine Tools

Generally speaking, there is no market for machine tools as yet, in Jugoslavia, Bulgaria, or Roumania. Poland and Czechoslovakia are possible buyers, but the credit conditions in the former country make any business transactions difficult. Roumania needs railway shop equipment, but the political conditions make it extremely difficult to do business with this government. Austria and Hungary both have industrial concerns of importance, and the need for machine tools is unquestionable; but here again the financial conditions are an almost insurmountable obstacle.

With regard to the type of machine tools that could be sold in those countries where any business at all is possible, it might be stated that there is no market for such lines as planers, lathes, or heavy shipbuilding machinery. The market is confined to more special machine tools, such as gear-cutting machines, large automatic machines, grinding machines of all kinds, high-speed saws, and rotary bevel shears. In some of these lines there is, of course, German competition to contend with. Grinding wheels and proper instructions as to their use are needed in all the countries visited, as the wheels now being used are very unsatisfactory.

* * *

There are more telephones in proportion to population in the United States than in any other country in the world, there being one telephone for every eight inhabitants. Denmark comes next with one telephone for every twelve inhabitants, and Sweden follows with one telephone for every fifteen. Next comes Norway, with one telephone for twenty-one, and England with one for every forty-seven.

Advantages of Built-up Die Construction

C. E. STEVENS, Chief Engineer, White Sewing Machine Co., Cleveland, Ohio

BUILT-UP dies are those in which the surfaces that are subjected to wear and that are difficult to machine are made in two or more parts and properly assembled. That there are advantages in such a construction is evident. Not only is the cost of making the die reduced and the machining of the impressions simplified, but also repairs may be readily made without the expense of replacing an entire die member. No essential points of die design should be sacrificed, however, in order to use a built-up construction in place of a solid die.

Points that should not be overlooked in designing dies, especially when they are to be used for quantity production, are: (1) The safety of the operator; this is of first importance, because it is very easy for an operator to be injured for life while feeding a power press. (2) Rapidity of operation; the dies should be designed to enable the operator to perform the work as rapidly as possible. (3) The combining of operations; this should be done whenever possible, but not to such an extent that the design will become so complicated as to cause the cost of repairs to amount to more than the net savings derived from combining operations.

The points of design mentioned have been incorporated in a set of dies for producing the rheostat base shown in Fig. 1, and it is believed that these dies are so constructed that the productive and repair cost is much less than for dies of solid construction. The rheostat base is made from a strip of soft cold-rolled steel, 5 inches wide by 0.035 inch thick, and there are four sets of dies used in completing the base. First the stock is perforated, then blanked, formed, and finally the lugs are produced. Three of the dies used in making the rheostat base are illustrated in this article.

Perforating Die of Built-up Construction

The first die used in the operations on this part is a perforating die of built-up construction. This is used for piercing four small round holes, two square holes and four slots in the strip, as shown in Fig. 2. The position of the stock before it is fed into the dies is shown by a heavy broken outline; the outline of the blank and the position of the holes pierced are also indicated. The die consists of a cast-iron shoe milled to receive die-block *A*, into which a center block *B* is fitted. The shape of this center block is shown in the lower right-hand corner of the illustration. It will be seen that the slots and openings that produce the square holes in the die can be readily milled in this block. The simplicity of producing the die openings in this way greatly reduces the cost of construction over that required when each opening is cut from the solid.

The center block is a press fit in block *A*, and both these members are made from oil-hardening tool steel. The larger block is fastened to the die-shoe by machine screws and dowel-pins. The stock is fed between two cold-rolled steel guide strips *C* and *D*, over which, at each end of the die the machine-steel members *E* and *F* are bridged. The guide strips are 1/8 inch thick, which provides sufficient clearance for the stock to pass under the bridge pieces. The guide strips and the bridge pieces are fastened to the die-shoe by machine screws and dowel-pins. Bridge piece *F* contains a slot in which the stop-finger *G* is held. This stop is operated at every downward movement of the press ram, by means of a trip screw attached to the punch holder.

The stripper *H* is of the familiar spring type, and is attached to the cast-iron punch-holder by screws, and guided by two posts which are a press fit in the stripper and a slip fit in the punch-holder. The stripper is operated by six coil springs of square-section wire. Both the punch pad *J* and the stripper are of the same construction as the guide blocks; that is, they are each made in two parts. By this construction, the center block for the die and the ones used in the stripper and punch pad may be milled as one piece, thus insuring perfect alignment of the punches with the holes in the stripper and die-block. The flat punches for piercing the slots are made of B & S ground stock; they are riveted over in punch pad *J* and are well supported by the stripper. Excellent results have been obtained with this construction.

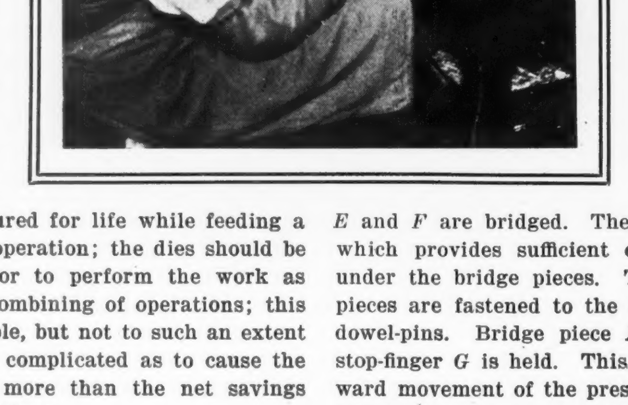


Fig. 1. Rheostat Base produced with Dies of Built-up Type

In setting up the die in the press, the stripper springs are compressed enough to allow the punches to protrude beyond the stripper about 3/16 inch, in which position they are temporarily held by set-screws tightened against the shoulder screws that hold the

stripper to the punch-holder. After the punches have been aligned with the holes in the die, these set-screws are, of course, released.

Dies for Blanking

The second operation in the manufacture of the rheostat bases consists of blanking the pierced stock in the die shown in Fig. 3. The general construction of this die is not greatly different from that of the perforating die. It is of built-up construction, the die opening *A* being made of four sections, two straight pieces for the sides and two end pieces *B* in which the contour for the corners is milled. The shape of these end pieces is shown in the lower right-hand corner of the illustration. Each of the four sections is fastened to the die-block by two ¼-inch fillister-head machine screws and one dowel-pin.

The stripper plate *C* is made of machine steel, and it bridges the front and rear guides, after the general construction shown in Fig. 2. The slot for the feed-stop is cut in this stripper plate. Punch *D* is a solid piece of tool steel, fastened to the cast-iron punch-holder, and contains two pilot pins, which locate the stock from two punched holes diagonally opposite each other. In the operation of both the piercing and the blanking die, the strip stock is continuously fed through, being automatically stopped at each operation of the ram by the stop-finger. The press on which these dies were used operated at a rate of 112 strokes per minute on this job.

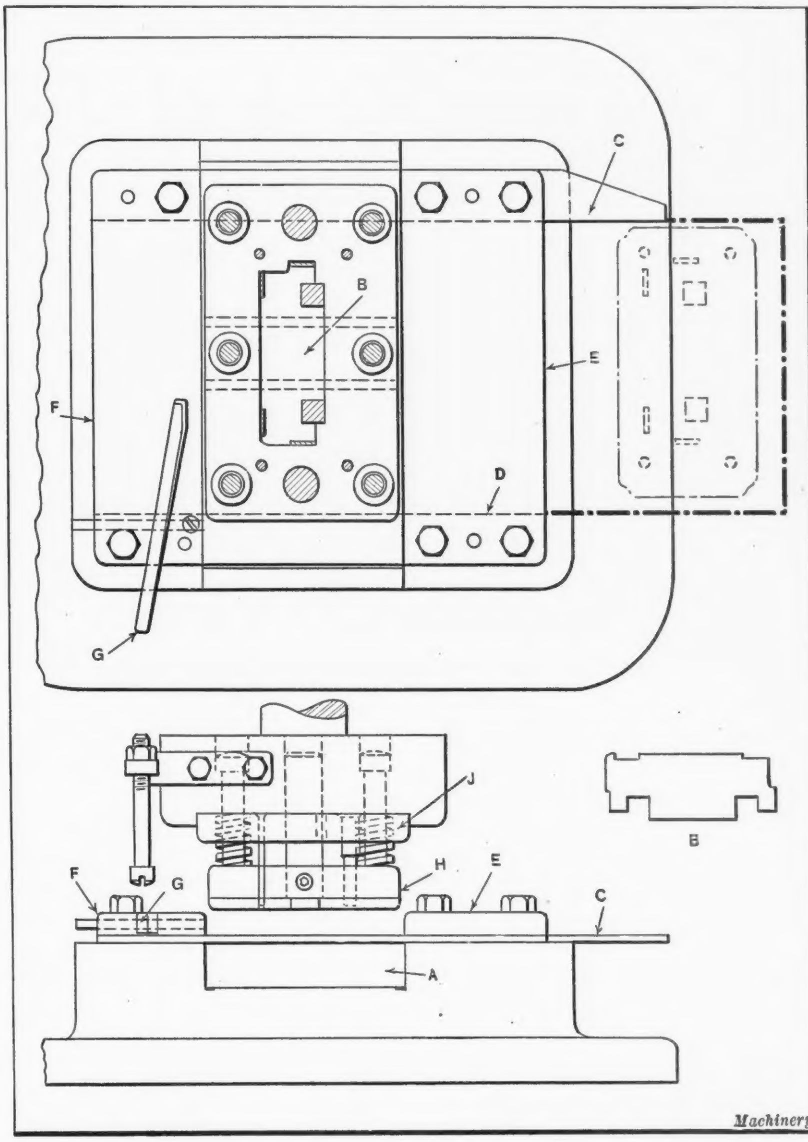


Fig. 2. Piercing Dies having Opening formed by Machined Blocks set into the Die-shoe

Construction of the Forming Die

The design of the forming die is not illustrated. The cast-iron die-shoe is cut out to receive four steel strips, which, when assembled, form the upper corners of the die opening, in which a weight-operated pressure-block is a sliding fit. The pressure-block and the four forming strips are of hardened tool steel. There are two gage strips fastened to the die-block by screws and dowel-pins at each side of the die opening, these strips being shaped to serve as stops when the blanks are fed into the die. The contour of the surface of these strips is the same shape as the corners of the blank (see Fig. 3). These strips are located back from the die opening enough to allow stock to form the sides of the rheostat base (see Fig. 1).

Above these gage strips, and also located on the sides of the die opening, are two stripper blocks, each of which has two projections extending in toward the die opening sufficiently to engage the formed side of the rheostat base and strip it from the punch on the upward stroke of the press. The screws and dowel-pins used to attach the gage strips also fasten the stripper blocks in place. The punch is of tool steel, and is attached to a cast-iron punch-holder by means of two dowel-pins, which also act as pilots to locate the blanks from the two square holes.

The die is provided with a feeding device of the chute type, which is capable of accommodating three blanks at a time. In operation, this feeding device is loaded and the blanks pushed along until one has been properly stopped under the punch. While this blank is being formed, the operator places a fourth blank at the edge of the chute so that as soon as the ram has ascended, the next blank may be fed along to the operative position.

The formed work is blown from the die by compressed air and deposited in a container at the back of the press. The valve for controlling the compressed air is operated by the upward stroke of the press. The weight-actuated pressure-block, previously mentioned, ejects the formed blank, bringing it to the level of the die so that the compressed air can remove it from the face of the die. There is little danger of injury to the operator with a die which is operated and constructed in this manner. When a formed part is produced at every stroke of the press ram, the rate of production is about thirty per minute.

Dies for Shearing and Forming the Lugs

The final operation in making the rheostat base is performed in the die illustrated in Fig. 4. The point of special interest in the construction of this die is that the die-block *A* is made in two pieces, as shown in the sectional view in the center of the illustration. Each of these pieces can then be readily milled to produce the die openings, which are in the form of a cross. These two blocks are set into the cast-iron die-shoe, and fastened by four fillister-head machine screws and two dowel-pins. Within the cross-shaped die openings there are two plungers *B*, each of which is actuated by a coil spring made of square-section wire. These coil springs surround the shank of the plungers, and a plate is set into the bottom of the die-shoe to support the springs. The springs furnish enough tension to eject the formed piece of work from the die.

The punches C shear the two square holes at the corners and bend the lips thus produced to a 90-degree angle to form the lugs. These punches are made of tool steel, and are provided with a 30-degree angle shearing edge at the corners, while at the ends there is a clearance of 0.035 inch (equal to the thickness of the stock) so that there may be space for the lug to be formed. The corners of the die A over which these lugs are bent are slightly rounded to facilitate the operation. The punches are set into the machine-steel punch-pad D and riveted over, and are provided with tool-steel pilots of sufficient length to project 1/32 inch beyond the lug formed on the work. The purpose of this is to force plungers B down ahead of the lugs being formed so that they will not interfere with the free cutting and forming action.

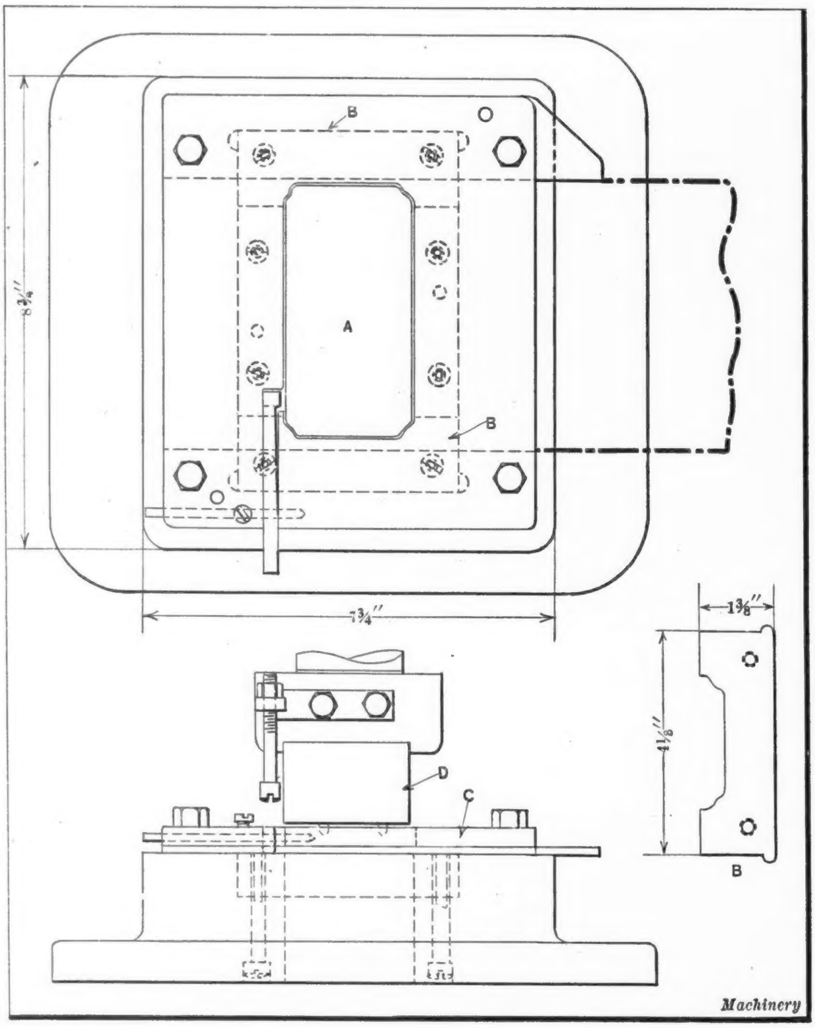


Fig. 3. Blanking Dies of Built-up Construction

The punch-pad is of two-piece construction like the die-block A, and the two pieces of the pad and of the die-block are all milled at one time. This gives the required alignment and also saves considerable time in machining. The punch stripper E is a machine-steel part, held in place by the customary arrangement of screws, and operated by four coil

The formed work is placed over the die-block, which is an easy fit inside the work. Any play between the work and the die-block is compensated for by the pilots on the punches which enter the square holes before they are sheared, and locate the work. In this particular case, it is necessary that the operator put each piece on the die separately. To prevent accidents when this is being done, the press is equipped with a safety device. It is also equipped with compressed air to keep the die clean. In setting up the die, the plungers B are depressed and locked in this position by set-screws. Then the punch stripper is forced up so that the punches extend, where they are temporarily locked by set-screws while the punches are being aligned with the die openings.

The fact that all the dies used for this job are of built-up construction decreases the total cost of production and makes repairs easier and cheaper, thus also reducing possible delays.

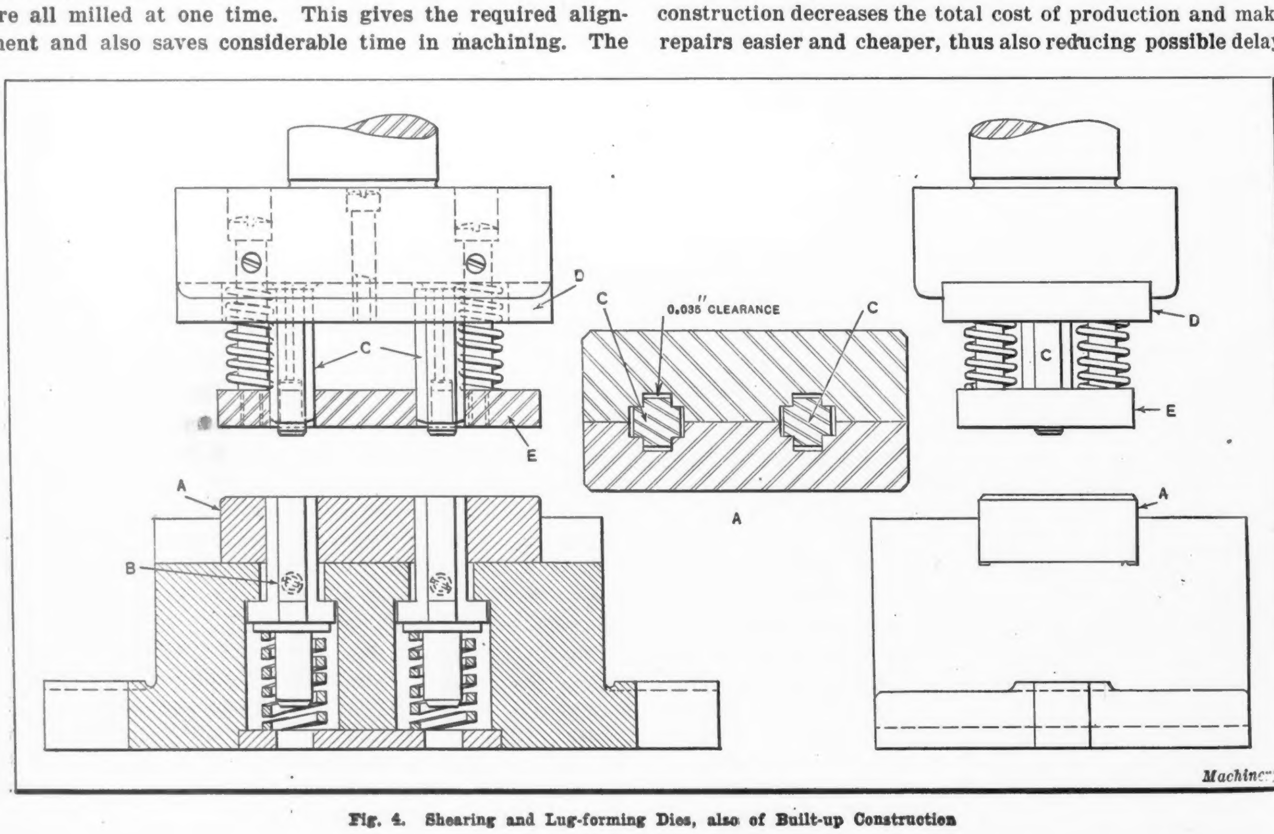
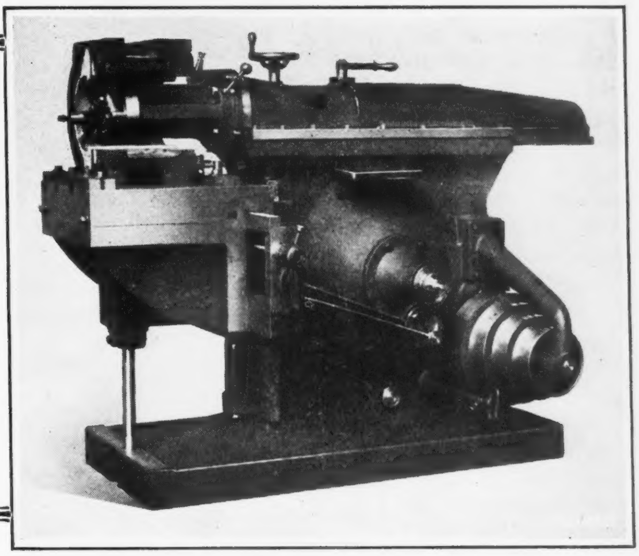


Fig. 4. Shearing and Lug-forming Dies, also of Built-up Construction

Planer and Shaper Attachments

Special Equipments that Adapt Planers and Shapers for Performing Unusual Operations

By EDWARD K. HAMMOND



FREQUENTLY a planer or shaper must be adapted for performing operations that cannot be handled with the ordinary equipment found on machines of these types. In such cases, an auxiliary attachment must be provided. For instance, while a planer cannot cut zigzag oil-grooves in slide bearings or plane concave or convex curved work, it is not difficult to make planer attachments that will enable such work to be performed economically. Likewise, shapers can be readily adapted for performing surface grinding operations, finishing internal or external cylindrical surfaces, and for various other operations.

Attachment for Planing Zigzag Oil-grooves in Slide Bearings

An attachment for planing zigzag oil-grooves in slide bearings, made by the Hanson-Whitney Machine Co., Hartford, Conn., is shown in Fig. 1. It is shown working on the inclined side *A* of a dovetailed slide, but it will be seen that this piece of work is set up in a fixture *B* in such a way that the surface in which the oil-groove is being planed is held in a horizontal position. The design of this fixture is such that it is a simple matter to work on surfaces at any angle from the horizontal to the vertical. This is accomplished by using the attachment in conjunction with either the rail-head or the side-head of the planer, and swiveling the head to bring the tool into the required position. On this oil-groove cutting attachment, as regularly furnished, the maximum length of groove that can be cut is 30 inches; the maximum width of the zigzag path for the oil-groove is $1\frac{1}{4}$ inches; and the minimum width of the zigzag is $\frac{3}{8}$ inch. A complete description of the mechanism of this attachment and of the method of attaching it to a planer was published in October, 1920, MACHINERY.

Planer Radius Attachments

Figs. 2 and 3 illustrate a 30- by 30-inch by 10-foot open-side planer, equipped with an adjustable radius planing attachment which is adapted for work having a radius of curvature ranging from 5 to 15 feet. This machine is built by the Cleveland Planer Co. In order to understand fully the way in which the equipment operates, reference should also be made to Fig. 4, which shows the details of the mechanism.

The attachment is mounted on the planer table, by which it is reciprocated back and forth under the tool. It consists of a table *A* on which the work is mounted, and two radius rods *B*, the length of which may be adjusted to govern the radius of curvature to which the work is planed. These two radius-rods connect the table of the attachment with a fixed pivot point, so that as the planer table moves back and forth in a straight line, the attachment is also moved transversely across the planer table.

This combination of lateral and transverse movements causes the work to be planed to a radius of curvature governed by the position of the pivot point, which is adjustable to suit the requirements of different jobs. By

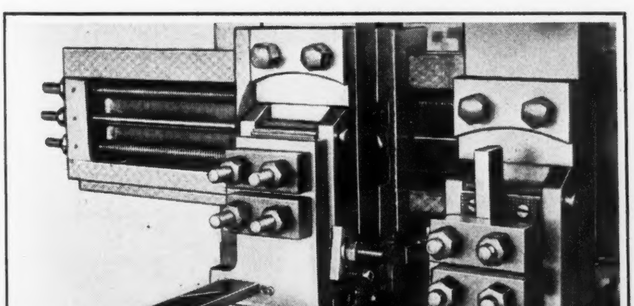


Fig. 1. Cam-actuated Attachment which adapts a Planer of Standard Design for cutting Zigzag Oil-grooves in Slide Bearings

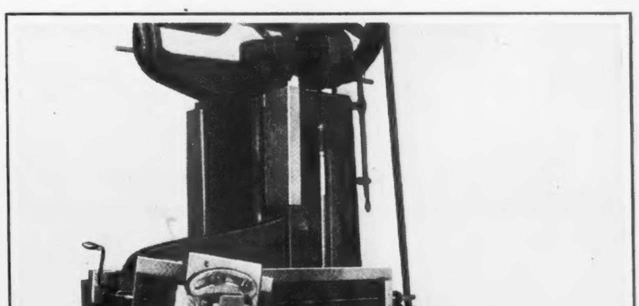


Fig. 2. Close-up View of Radius Planing Attachment for Use on an Open-side Planer. Adjustment is furnished for Different Radii

referring to Fig. 4 it will be seen that table *A* of the attachment has two offset portions at each end, over which caps *C* are secured to hold the table down. The two radius-rods *B* are connected to the table as previously mentioned, and beneath the table there is a link *D* with a stud hole at each end. The stud *E* which enters one of these holes is secured to the top of the main planer table, while the stud *F* in the other hole is held in the bottom of the auxiliary table. This arrangement causes a uniform reciprocating transverse movement to be imparted to the table of the radius planing attachment as the planer table reciprocates back and forth under the cutting tool. An attachment of this kind enables radius planing operations to be performed on a vertical plane on the work. Brackets *G* support the ends of the table *A* as they swing out from the main planer table.

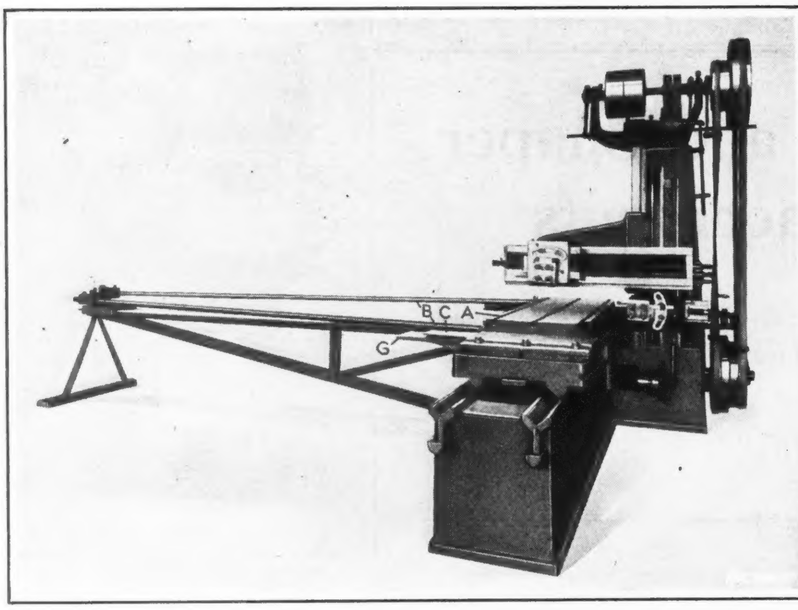


Fig. 3. Open-side Planer equipped with the Radius Attachment shown in Fig. 2

Planing Concave Radial Surfaces

The cylinders at each side of a locomotive are separate castings, finished with a flanged joint between the two castings for bolting them together. At each side of this joint, a concave radial surface must be planed over an angle of approximately 90 degrees, forming a semi-cylindrical seat that receives the under side of the smokebox of the engine. It is required to have each of these radial surfaces of the cylinder castings accurately machined, and the usual practice is to handle this work on a planer. At the Burnside shops of the Illinois Central Railroad Co., in Chicago, Ill., a very simple method is used for performing this radius planing operation, the scheme being illustrated diagrammatically in the illustration Fig. 5.

The job is done on a planer having two heads on the cross-rail. One of these heads is connected to the feed-screw in the usual manner, while the other head is released from the screw and is allowed to swing freely on its pivotal support, although it is secured against longitudinal movement on the cross-rail. Each of the planer heads is drilled to receive a pin *A*, and a link *B* is put over these pins to connect the planer heads at the top. Then, in the head that has been released from the feed-screw, a tool-holder *C* is mounted so that the distance from the pivot *D*, about which the planer head swings to the cutting point of tool *C*, is equal to the radius of curvature which it is required to plane on the work.

After the cylinder casting has been properly located under this attachment, the planer is started with a suitable rate of feed to traverse the right-hand head along the cross-rail. Evidently, this movement of the head causes link *B* to swing the left-hand head about its pivot *D*; and as a result, the point of tool *C* swings over the work and generates a concave surface of the required radius of curvature. This special equipment can be quickly removed when regular work is to be done.

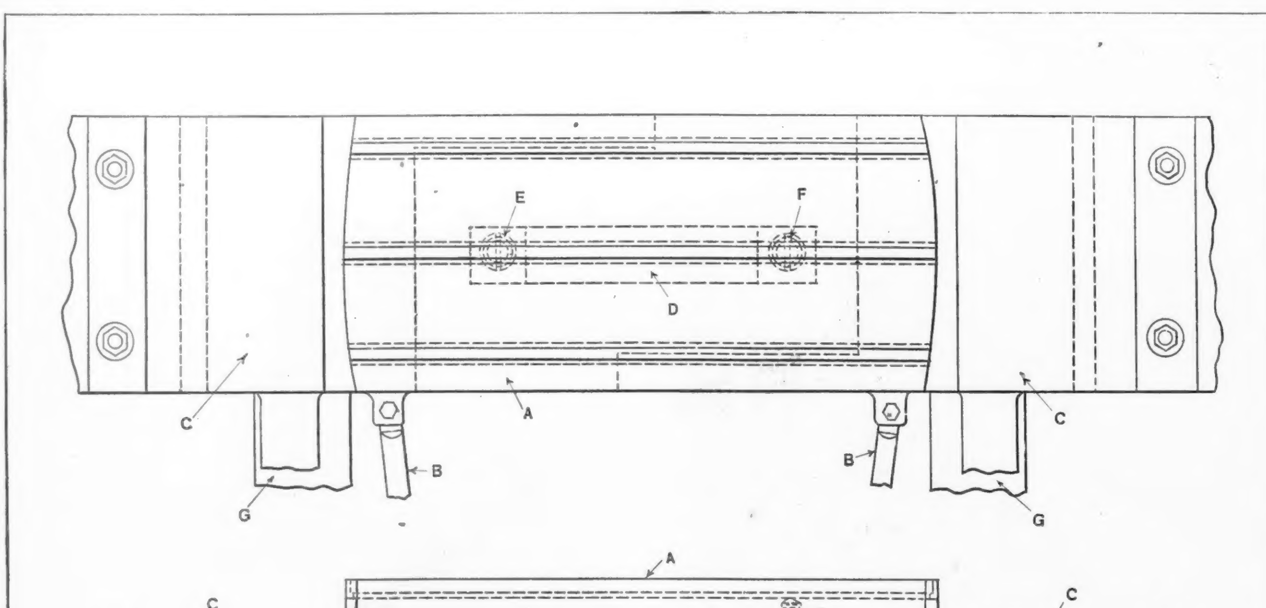


Fig. 4. Arrangement of Mechanism of the Radius Planing Attachment shown in Figs. 2 and 3

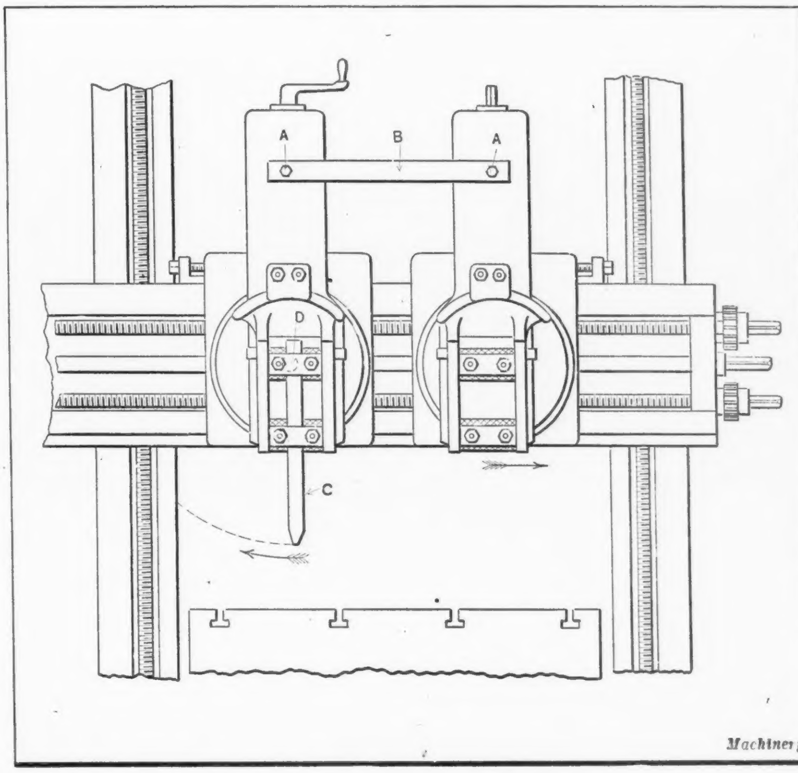


Fig. 5. Radius Attachment used for planing Smokebox Seat in Locomotive Cylinders

Planing Irregular Curved Surfaces

In building ironing machines for use in laundries, it is necessary to plane cast-iron beds which have an irregular curved surface. An ingenious method of planing these curved surfaces has been worked out by builders of these ironing machines, and as a similar procedure might be followed in the manufacture of other products, the way in which this planing operation is performed will be described. It should be understood that the surface of this work follows curves which are not only irregular, but which change from convex to concave while the tool is moving over the work from left to right. Hence, it will be apparent that a satisfactory method of planing such a piece would also be applicable to work of either concave or convex form, and of any reasonable radius of curvature.

Fig. 8 shows, in diagrammatic form, the attachment developed for handling this job, and from the illustration it will be apparent that the principle of operation is simple. In the present case, two tool-heads are utilized in order to expedite the planing of a piece of work of considerable length, as one head is able to start at the left-hand end and one in the middle, thus cutting the production time in half. However, the same principle of form-planing could be applied on a planer equipped with either one or more than one tool-head on the cross-rail. Secured to the top of each planer head, is a bar *A* carrying a cam-roller *B* which runs in contact with a master form *C* of exactly the same shape and size as the work to be planed. This master form is secured between the planer housings so that its straight lower surface is located above and parallel with the cross-rail of the machine.

The planer heads are fed along the cross-rail in the usual manner, but the nuts are released from the vertical feed-screws, so that as each head travels along the rail, the vertical position of the point of tool *D* is governed by engagement between the cam-roller *B* and the master form *C*. As a result, the work is planed to exactly the contour of this form, which has been carefully developed for that purpose. One of the advantages of a planer attachment of this kind is that the planer can easily be adapted for handling other work. Unless the full vertical capacity is required, it is possible to leave the master form *C* in position between the housings and merely disconnect the links *A* from the tool-heads and connect the vertical feed-screws to the planer heads. This enables the machine to be used for other operations.

Grinding Attachments for the Planer and Shaper

It is sometimes desirable to equip a planer or a shaper for performing surface grinding operations. Examples of machines so equipped are shown in Figs. 6 and 7. Fig. 6 shows an open-side planer built by the Cleveland Planer Co., and Fig. 7 shows a shaper built by the John Steptoe Co., of Cincinnati, Ohio. These illustrations make the arrangement

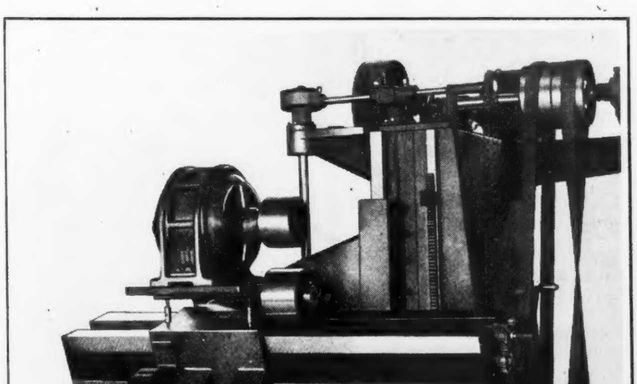


Fig. 6. Open-side Planer equipped with a Special Grinding Head on the Cross-rail for grinding Railway Crossings after planing

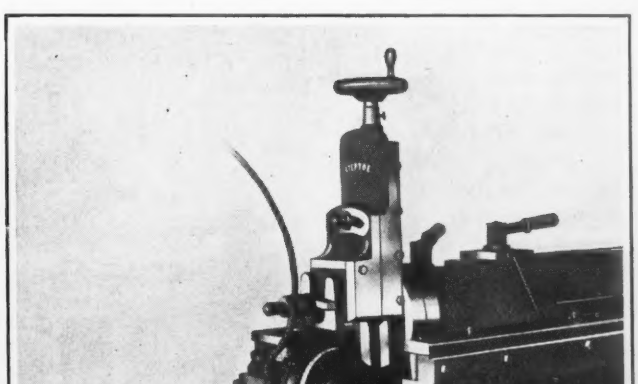


Fig. 7. Shaper furnished with Portable Grinding Machine in the Toolpost for performing Surface Grinding Operations on Small Work

and use of both of these attachments quite clear without requiring detailed descriptions, but it may be menticned that the open-side planer shown in Fig. 6, was furnished with a motor-driven grinding head on the rail for grinding railroad crossings to a smooth finish, after planing. Similarly, a small electric grinding head is secured to the clapper of the shaper shown in Fig. 7 to adapt this machine for performing surface grinding operations on small and medium-sized pieces of work. Both of these attachments are in the nature of makeshifts, and are not intended for performing grinding operations on regular production work.

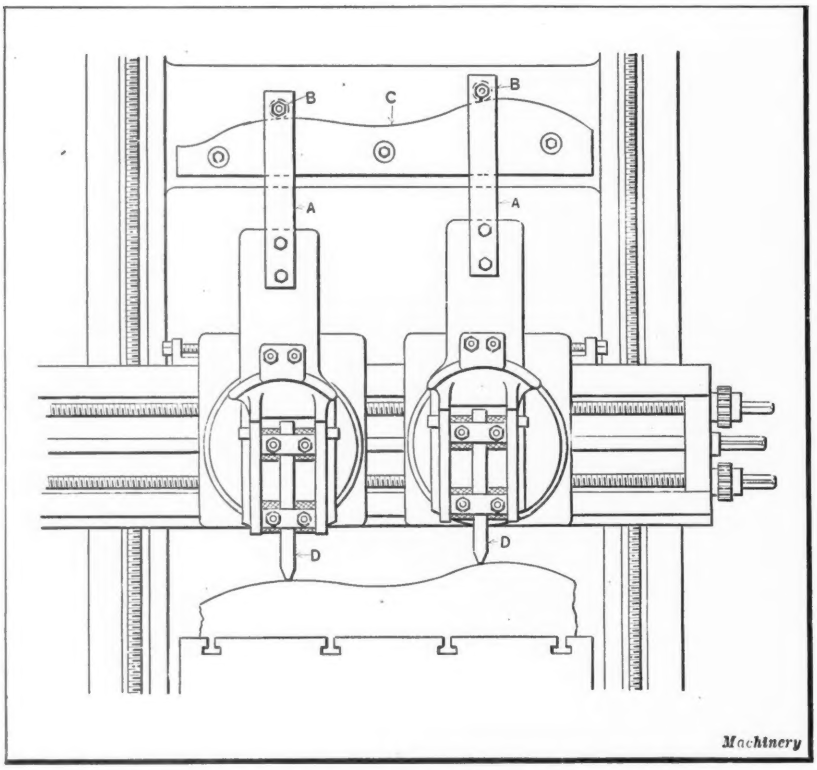


Fig. 8. A Planer Radius Attachment used for planing irregularly Curved Cast-iron Beds of Ironing Machines

Radius Planing Attachment for a Shaper

Fig. 9 illustrates a shaper with a traversing head, built by Gould & Eberhardt, of Newark, N. J., which is equipped for performing a radius planing operation. This is accomplished by removing the short rail that carries the tool-head from the shaper ram, and bolting it to a radius arm *A*. At the left-hand end of this radius arm a number of holes are drilled so that the attachment can be set up in such a manner that the distance from the pivot *B* to the cutting point of the shaper tool, is equal to the radius of curvature which it is required to plane in the work. At the right-hand end, the radius arm is secured to the ram by means of a pivot *C*. Bearing in mind that the tool-head is carried on the radius arm, it will be evident that as the ram reciprocates back and forth, the point of the tool will generate a surface with a radius of curvature equal to the distance from the pivot *B* to the tool-point. This distance can be adjusted by putting pivot *B* into different holes in the left-hand end of arm *A*. Obviously, the pivot *C* must be held in a lengthwise slot in arm *A*, to allow for the change of distance between pivots *B* and *C* while the shaper ram is reciprocating.

Radius Attachment for Emergency Use

Fig. 10 illustrates a form of radius planing attachment which may be used in an emergency. The way in which this device operates is so clearly shown in the illustration that only a brief description is necessary. A concave curved surface is to be planed on the work at *A*, and to accomplish this result the tool is mounted on a pendulum link *B*, the distance from the center of oscillation of this link to the point of the cutting tool being equal to the required radius of curvature of the work. A pivoted link *C* connects the lower end of the tool-carrying pendulum with the tool-box on the shaper ram, so that as the ram reciprocates back and forth the tool planes the work to the desired form.

Attachment for Cutting Oil-grooves on the Shaper

When it is required to cut straight oil-grooves in bushings, without having them run out at either end, such work can be performed rapidly on a shaper equipped as in Fig. 11. This illustration shows tools applied to a shaper built by the Cincinnati Shaper Co. The bushing *A*, in which the oil-groove is to be cut, may be clamped to the table in any convenient manner. Secured to the shaper toolpost there is a holder, at the lower end of which a pivoted bar *B* is carried. At an equal distance in either direction from pivot *C*, are held a cutter bit and a cam-roller that runs in contact with master cam *D*.

The rise on this cam is of the same form as the oil-groove which is to be cut in the work, the oil-groove being depressed an amount corresponding to the rise on the cam. As the shaper ram reciprocates, the cam-roller runs up over the rise on master cam *D* and the cutter bit is correspondingly depressed. A compression spring *E* maintains uniform contact between the cam and the roller, thus assuring the planing of the oil-groove to the required form. The tool may be fed to depth either by hand or automatically.

Hacksaw Attachment for the Shaper

In Fig. 12 is illustrated a simple means of adapting a Cincinnati shaper

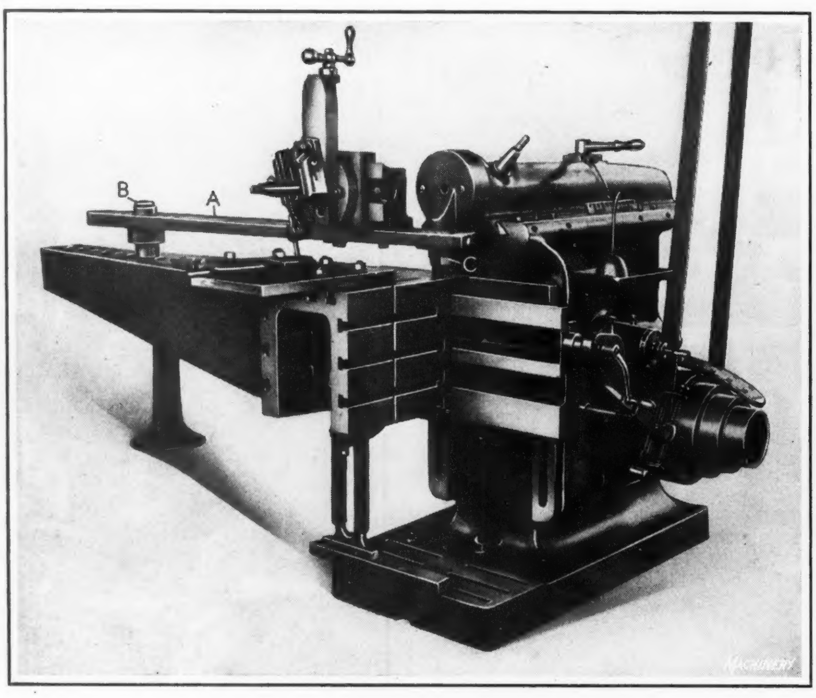


Fig. 9. Radius Planing Attachment for the Shaper

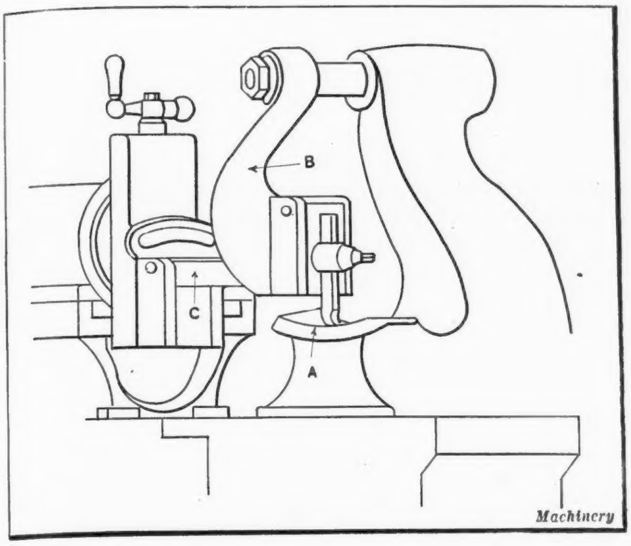


Fig. 10. Radius Planing Attachment for Use on a Crank Shaper

for use as a power hacksaw machine. This consists of the attachment of a saw frame to the tool-block on the ram. For a shop in which there is considerable amount of sawing to be done, such a method is not desirable; but in cases where it is occasionally necessary to do some cutting that is beyond the usual scope of a hand-operated hacksaw, a device of this kind constitutes an inexpensive and reasonably efficient means of handling the work.

Application of Index-centers on the Shaper

A jobbing shop is often called upon to execute orders for repair work on gears, and an occasional operation of this

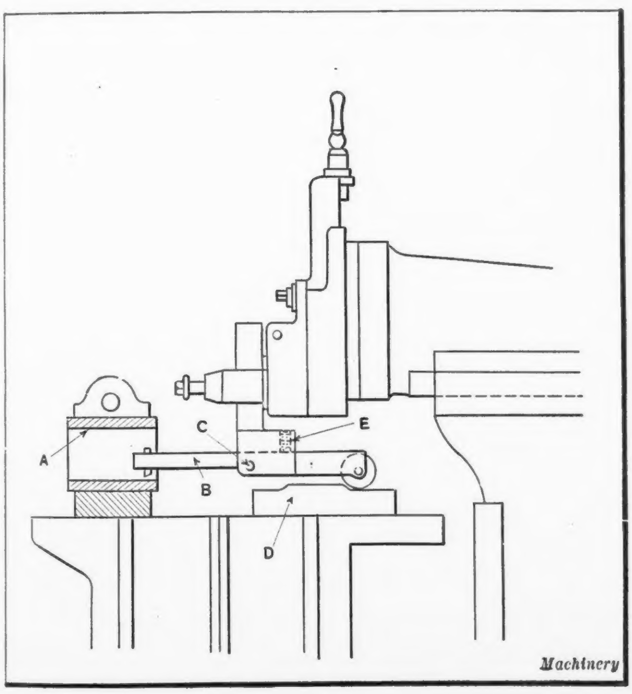


Fig. 11. Tool Equipment for shaping Oil-grooves in Bushings

kind can be handled on a shaper furnished with a set of index-centers. Fig. 13 illustrates a machine built by the John Steptoe Co., which is furnished with index-centers of this firm's manufacture.

In shops maintained by railroad or mining companies, far away from industrial centers where replacement gears could be purchased, a shaper is often used for repair work, instead of buying an expensive gear-cutting machine, for which there would be little regular work. The method of procedure is to form a piece of steel to approximately the shape of the tooth, insert it in the gear, and then plane this insert to the required tooth form with the shaper tool

Obviously the shaper tool must be finished to exactly the same shape as the space between two teeth of the gear on which the repair is being made.

* * *

SPRING MEETING OF THE A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers will be held at Montreal, Canada, May 28 to 31. The following subjects will have specific sessions devoted to them: Power, Textiles, Railroads, Management, Paper Machinery, Port Developments, and Fuels. Following the meeting there will be excursions to Quebec and to points north and east of Montreal. The Engineering Institute of

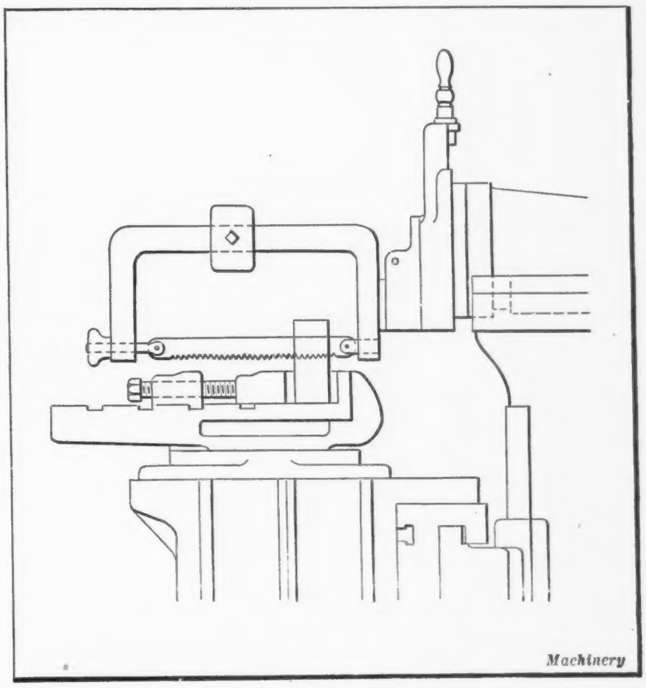


Fig. 12. Shaper equipped for Use as a Power Hacksaw Machine

Canada is cooperating with the society in the plans for the meeting.

Late in April a regional meeting of the American Society of Mechanical Engineers will be held at Los Angeles, Cal. Further information relating to these meetings may be obtained from the headquarters, 29 W. 39th St., New York.

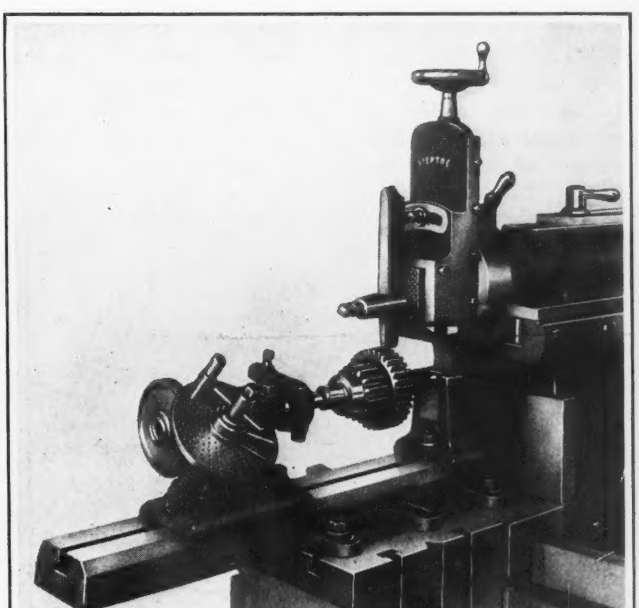


Fig. 13. Use of Index-centers and a Formed Tool for performing Gear Tooth Planing Operations on the Shaper

Ratchet Mechanisms

By C. M. LINLEY

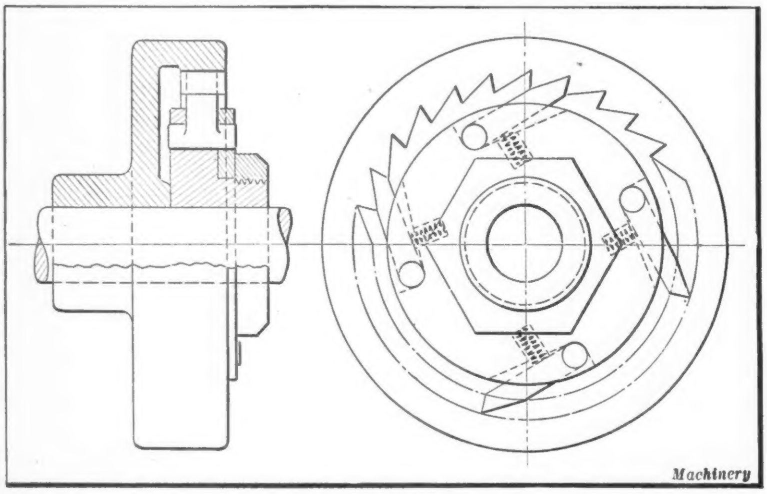


Fig. 1. Internal-tooth Ratchet especially Suitable for High-speed Drives

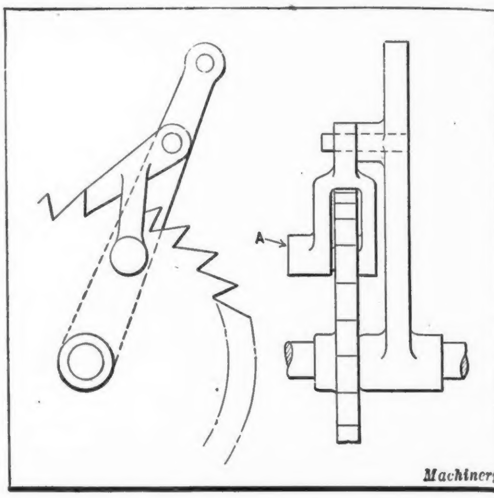


Fig. 2. Ratchet Mechanism with Silencing Device

IN the design of ordinary ratchet mechanisms, care should always be taken to so locate the fulcrum and make the contact face of the pawl of such an angle that the pawl will engage a ratchet tooth immediately when pressure is brought to bear upon it. Otherwise, the entire pressure may be placed on the pawl before it reaches the bottom of a tooth, and then the whole load will be transmitted by the part of the tooth in engagement with the pawl. Such a condition is likely to result in chipping away the teeth and the end of the pawl. A ratchet having internal teeth is the best design to employ in a high-speed drive, because centrifugal force tends to assist the action of the pawl; this is particularly true when the pawl is mounted on the driving member. Fig. 1 shows an internal-tooth ratchet in which power is transmitted to the driven member through the medium of four pawls, each of which is assisted in its engagement with the ratchet teeth by a small coil spring.

Silent Positive Ratchets

A common ratchet equipped with a silencing device is illustrated in Fig. 2. Boss *A* contains a spring plunger provided with a fiber tip. This plunger produces a slight friction on the ratchet sides and so causes the pawl to be lifted from the ratchet teeth on the idle stroke and kept from contact with the teeth until the working stroke. Many modifications of this principle are possible.

Another design having an almost silent operation is shown in Fig. 3. This ratchet must not be confused with the friction type. Power is transmitted by gripping the balls or rollers between surfaces *A* and *B* of the driving and driven members, not between cam surfaces. No springs are employed to bring the balls into place, gravity alone being relied on. Usually only three balls are in action; in the illustration it will be observed that ball *C* is not in engagement. Either member *D* or *E* may serve as the driver. When this mechanism is used in a drive where the movement need not be accurate, it is not necessary to machine the engaging surfaces, and iron castings serve well unless the strain is severe.

Imparting Varied Rotary Motion

Ratchets for imparting a varied amount of rotary motion to a shaft are often looked upon unfavorably by machine designers, because with such ratchets, in their ordinary form, the wear of parts results in uncertain operation. However, if the ratchet is of a frictional type, failure need not occur, because the ratchet will work satisfactorily provided certain points are attended to in the design.

In Fig. 4 is shown an ingenious ratchet consisting of a worm-wheel and a worm mounted on a forked lever. When this design is enclosed in an oil-tight case and the parts are properly made, it functions with a high degree of

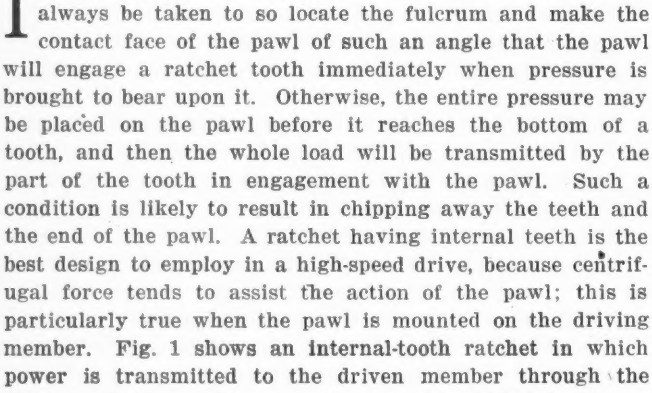


Fig. 3. Design that transmits Power by gripping Balls or Rollers between the Driving and Driven Members

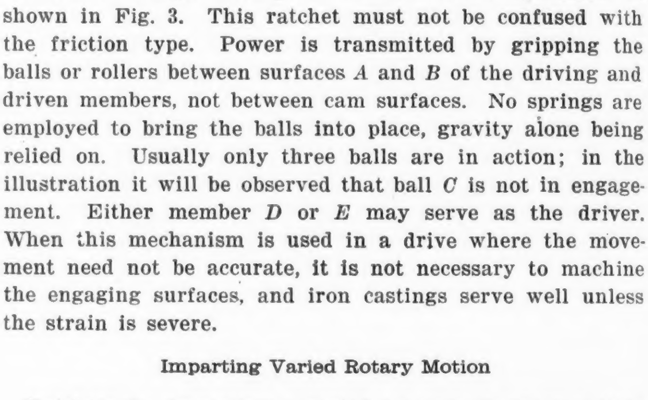


Fig. 4. Friction Ratchet in which the Worm rotates intermittently and the Worm-wheel revolves when the Worm stops

accuracy. However, it is a comparatively expensive arrangement. Either the worm or the worm-wheel may be used for driving the mechanism. It will be seen that the worm-shaft is equipped with a ball thrust bearing at *A* and is provided at *B* with a bearing that sets up an appreciable friction when subjected to a load. Bearing *B* and one race of bearing *A* are keyed to the shaft.

When the forked lever is operated in the direction indicated by the arrow, the thrust is against the plain bearing *B*, and the frictional resistance prevents the worm from revolving; hence the worm acts as a ratchet and turns the worm-wheel. On the contrary when the forked lever is operated in the opposite direction, the worm revolves, because it overcomes the relatively slight friction of bearing *A*; consequently, the worm-wheel remains stationary while the worm is swung backward.

By regulating the amount that the forked lever is moved in the counter-clockwise direction when the worm is the driving member, the movement of the worm-wheel can be varied. This device should not be regarded as a worm and worm-wheel mechanism in the ordinary sense, as no rubbing action takes place between the worm and the worm-wheel teeth when the two members are under a load. Added advantages of this construction are taking up the load without shock, and silent operation. An important point to be observed in designing a ratchet of this type is to make the helix angle of the worm such that the worm will just revolve when the load is on bearing *A*, and will remain stationary when the load is on bearing *B*.

Other Types of Friction Ratchets

Two more styles of friction ratchets are illustrated in Fig. 5. In the one at *A* the driving rollers are jammed between an internal circular surface of the outer member and cam surfaces on the inner member. With a ratchet of this type, springs are often utilized to force the rollers into contact with the jamming surfaces. One disadvantage of this design is that the rollers always bear at the same point on the inner member with the result that in time a depression is formed on each curved surface as shown at *C*. When this occurs, the device can no longer be relied upon, as a jamming action is impossible because of the shoulders that are formed. The ratchet shown at *B* was designed to overcome this disadvantage. The outer member is placed slightly eccentric relative to the center about which the inner member revolves, as indicated by the dotted lines, and so the jamming of the rollers is distributed on each curve between points *D* and *E*. By this provision the forming of depressions is obviated.

A final type of friction ratchet, which is fairly reliable in the ordinary form, when the disk is concentric, is shown in Fig. 6. However, if the disk is slightly eccentric relative to the fulcrum of the lever to which the engaging segment is attached, much better results will be secured, because the jamming is again distributed over a considerable area of the segment surface, and the forming of a depression on this member is avoided. This will be apparent by reference to the dotted positions of the ratchet disk and segment. Care must be taken to see that the amount of eccentricity is not too great, or the segment will not jam properly on one half of the disk periphery.

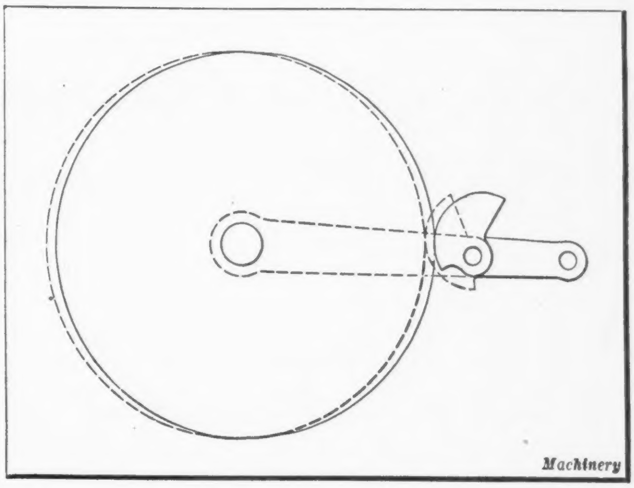


Fig. 6. Friction Ratchet consisting of a Disk, Segment, and Lever

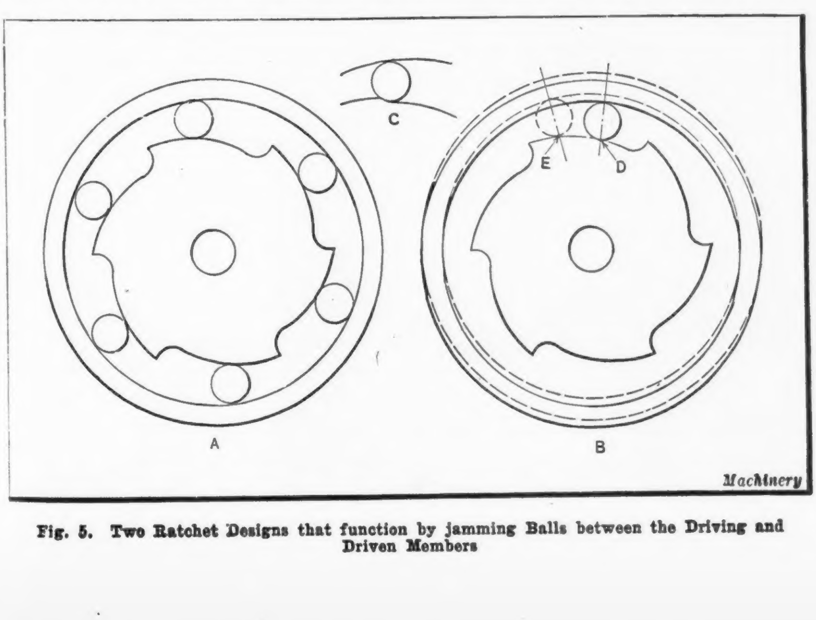


Fig. 5. Two Ratchet Designs that function by jamming Balls between the Driving and Driven Members

* * *

CUTTING METALS BY THE USE OF THE ELECTRIC ARC

For general cutting of metals by the electric arc, graphite or carbon electrodes are used with a current of from 300 to 1000 amperes, depending on the nature of the work and the cutting speed desired. Many foundries make use of arc-welding equipment for repairing defective castings, and use the same apparatus for cutting off risers and burrs from castings. For cutting rivets, currents of from 400 to 600 amperes are usually employed. When using 400 amperes, a good operator will average from 1800 to 2000 rivets, 5/8 inch in diameter, in a ten-hour day. Some operators have cut as many as 2600 to 3100 rivets of this size, working on a piece-rate basis.

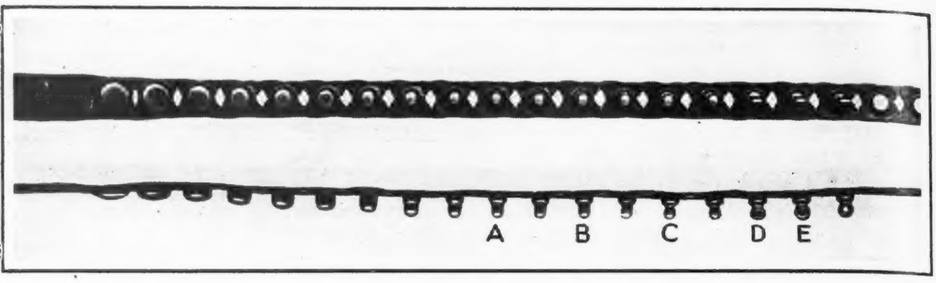
Cutting with the electric arc is not limited to iron and steel objects, but can be applied equally well to non-ferrous metals, such as brass, bronze, and copper. In fact for cutting copper which cannot be cut mechanically, the arc process is by far the cheapest to use. In cutting copper, current values of from 800 to 1000 amperes are used, because it is necessary to concentrate the applied heat at a sufficiently high rate to melt the copper before the heat is dissipated by the high heat conductivity of this metal.

* * *

EXPORT MANAGERS' MEETING

The 1923 meeting of the Export Managers' Club will be held March 20, at the Hotel Pennsylvania, New York. Among the subjects scheduled to be discussed at this meeting are the following: "Getting Results from the Sales Budget"; "Building Sales through Service"; "Manufacturers' Representative versus Merchant Distributor"; "Practical Problems of Marine Insurance"; "Discounting Drafts versus Collection"; and "Standardization of Practices." The meeting begins at 9 A. M., and there will be sessions in the forenoon, afternoon and evening. Those interested may obtain further information relative to the meeting from James S. Martin, Remington Typewriter Co., 374 Broadway, New York City.

Combination Follow-die



A POWER press die of unusual design has been developed in the plant of the V & O Press Co., Glendale, L. I., for use in the manufacture of brass button eyes. The shape and general proportions of these eyes are shown in Fig. 1. They are produced complete from ribbon stock in seventeen operations. The die is used on a No. 2 single-action, inclinable press of this company's manufacture. The heading illustration shows two views of a strip of stock; by referring to this illustration an idea of the successive steps in the manufacture of the eye may be obtained.

The dies, which are of built-up construction, contain more than 400 parts, and it is easily possible to replace or repair any part that is subjected to excessive wear without seriously disturbing the remaining parts of the tool. Fig. 2 shows the application of the die and the roll feed by which the stock is intermittently advanced through the dies. It would probably be impracticable to use a die having such a large overhang due to its extraordinary working length on a press of small size, if the machine did not have a full-length bearing for the vertical slide. This is a feature of the construction of the press.

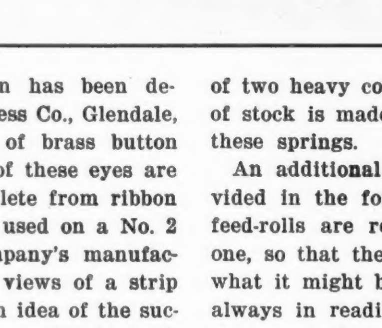


Fig. 1. Work shown to Enlarged Scale

The eyes are made from ribbon stock, 0.015 inch thick and 11/16 inch wide; the width is reduced during the various drawing operations to about ½ inch, as indicated in the heading illustration, leaving just enough scrap to hold the strip together. When many separate operations are performed successively, as in the present case, the liability of accumulative error in a roll-feed mechanism is considerable. For this reason, a release is provided for the roll feed, which operates just before the descent of the upper die member, permitting a locating punch at the farther end to enter a hole in the scrap prior to the operation of the drawing punches. This corrects any slight inaccuracy of alignment, and compensates for inequalities in feeding movement due to varying stock thickness or other causes. The release of the feed mechanism is accomplished by the adjustable screw *A*, which contacts with the handle *B* and lifts the top roll against the tension of two heavy coil springs *C*. Adjustment for the thickness of stock is made by the nuts that vary the compression of these springs.

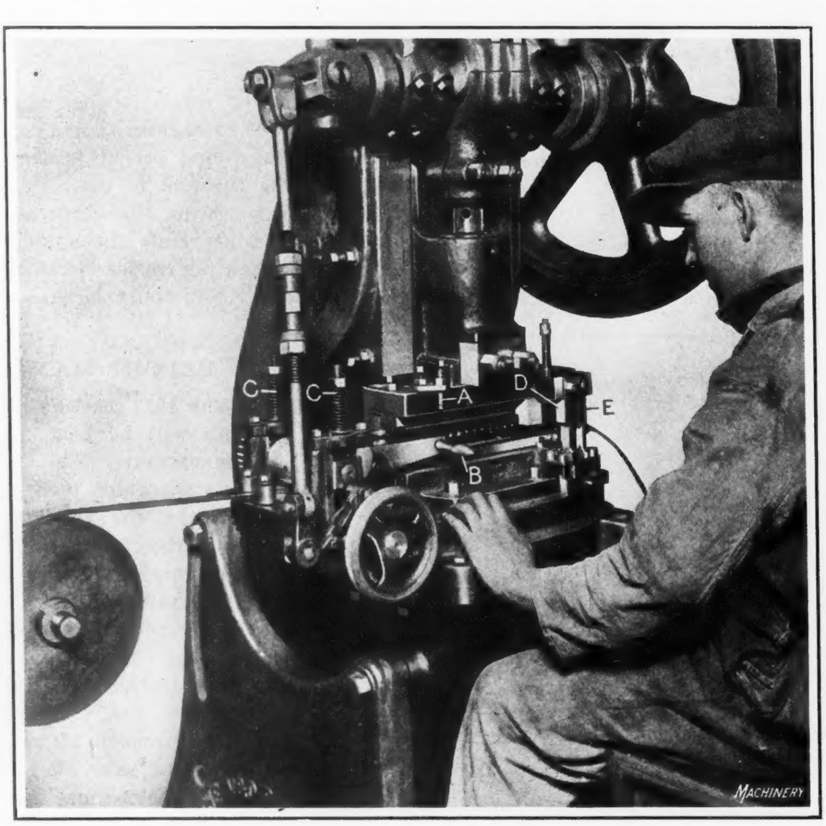


Fig. 2. Press equipped with Combination Button-eye Dies

An additional precaution against errors in feed is provided in the form of a ratchet mechanism, by which the feed-rolls are revolved. There are four pawls instead of one, so that the possible error is reduced to one-fourth of what it might be with a single pawl; that is, one pawl is always in readiness to engage a ratchet tooth with every movement that rotates the wheel one-fourth the pitch of the teeth.

Drawing and Redrawing Operations

Referring to the heading illustration, it will be apparent that the first punch produces a slit, which allows the stock to draw endwise as the eye is formed up. The second operation is drawing to 15/32 inch diameter and ⅛ inch deep, and the successive operations up to and including the eighth, are redrawing operations, producing a shell ¼ inch in diameter and 5/16 inch deep. The ninth, tenth, and eleventh are necking operations, which produce a shell ⅜ inch long and 11/64 inch outside neck diameter. The shape of the work after this step is indicated at *A*.

The next two shapes produced are shown at *B* and *C*. The dies used to form the head shown are set into the lower die member, and occupy more space than is regularly required, so that it becomes necessary to skip one regular spacing of the punches and use a dummy punch between the dies that form the piece to the shapes *A*, *B*, *C*, and *D*. The dies that close in the neck and form the head of the shell consist of a split collet *A*, Fig. 3, which is set into a button *B*. The collet is compressed by means of cap *C* as the punch descends and forces the work through the cap into the collet. When the punch ascends, the cap rises and the collet is forced open by the formed head on the shell. The shell is removed from the collet by the ejector. It is the space occupied by this mechanism that prevents the regular spacing of the die units.

The head is next flattened and a cir-

cular depression formed on each side, as shown at *D* in the heading illustration, and also in the enlarged section, Fig. 3. This is done preparatory to punching the eyehole, and consists of "underforming" on one side by compressing the metal, as indicated at the right in Fig. 3. If the stock were merely flattened as shown in the view at the left, the punch for producing the eye would cut a clean hole through one thickness of the stock only, and when it reached the other thickness it would tend to force the flattened head open instead of piercing the eye clear through. By under-forming one side, as mentioned, it is possible to punch the hole from the opposite side without destroying the part.

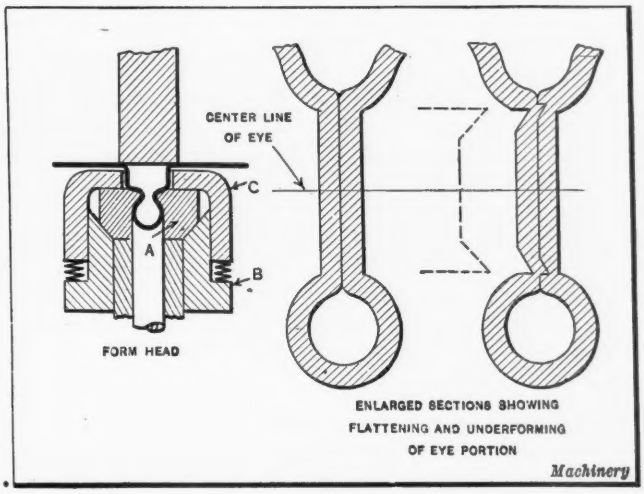


Fig. 3. (Left) Die Unit for closing in Head; (Right) Partial Sectional Views of Work before piercing the Hole

The punches that perform the operations of closing the head and under-forming are held in slides which are advanced horizontally toward each other from the back and front of the die, by means of two cams, one of which is shown at *D*, Fig. 2. The arrangement is similar to that employed subsequently in piercing the eye-hole. A sectional view of the cam-operated slide mechanism used in piercing the hole is shown in Fig. 4. The slides for flattening advance and pinch the head of the shell to compress it, while the strip of stock lies on a plate which spans the space between the front and rear slides. At the same time that these dies are compressing the lower end of the shell, similar dies carried in the same slide under-form the central eye portion of the next shell.

Piercing the Hole

Next comes the piercing operation, in which two other die-slides operated by cams *E* (Figs. 2 and 4), front and back, are employed. The front die-slide *A* (see sectional view) carries the die member, which is in the form of a hardened steel bushing, while the rear slide *B* carries the slender punch. As soon as the strip of stock advances to this station of the die, it is held flat by the vertical punch on the locating plate *C* which bridges the two slides. The punch carries a spring pad *D* which enters the drawn shell and locates it during the piercing operation.

The front slide is advanced by the cam until the die bushing *F* comes in contact with one side of the flattened work. A lug on this slide extends downward and carries a stop-screw which contacts with the lower end of the small vertical stripper lever *G*. This lever is pivoted to a member carried in the rear part of the die-bed. The upper end of this lever acts as the stripper for the punch, and when it is caused to pivot by the stop-screw, it bears against the rear side of the flattened eye, so that the work is held between the die bushing and the stripper lever.

The advance of the front slide results in an equal clamping pressure being applied to both sides of the flattened eye, thus correctly locating it without danger of its becoming unseated due to the thrust of the horizontal punch. The upper end of the stripper lever is cut out sufficiently to permit the punch-holder *H*, which is in the form of a sleeve, to enter. The sleeve gives the required stiffness to the rather slender punch. The scrap from the hole is forced through a passage in die bushing *F*, and from this passage an opening leads down through the front slide so that the scrap can fall through to a receptacle beneath. After the eye-hole has been punched, the stock is fed to the next station, where it is blanked from the strip and the completed piece is delivered through a chute to a receptacle.

The drawing dies are each provided with a spring ejector so that, at each stroke of the press, the strip is lifted from the face of the die sufficiently to be fed to the next position. The right-hand end of this composite die, in which the forming of the head and eye occurs, is provided with a spring which aids the ejectors in lifting this end of the scrap to the proper level for feeding. These button eyes are produced at the rate of ninety per minute. The die illustrated has produced several millions of these parts.

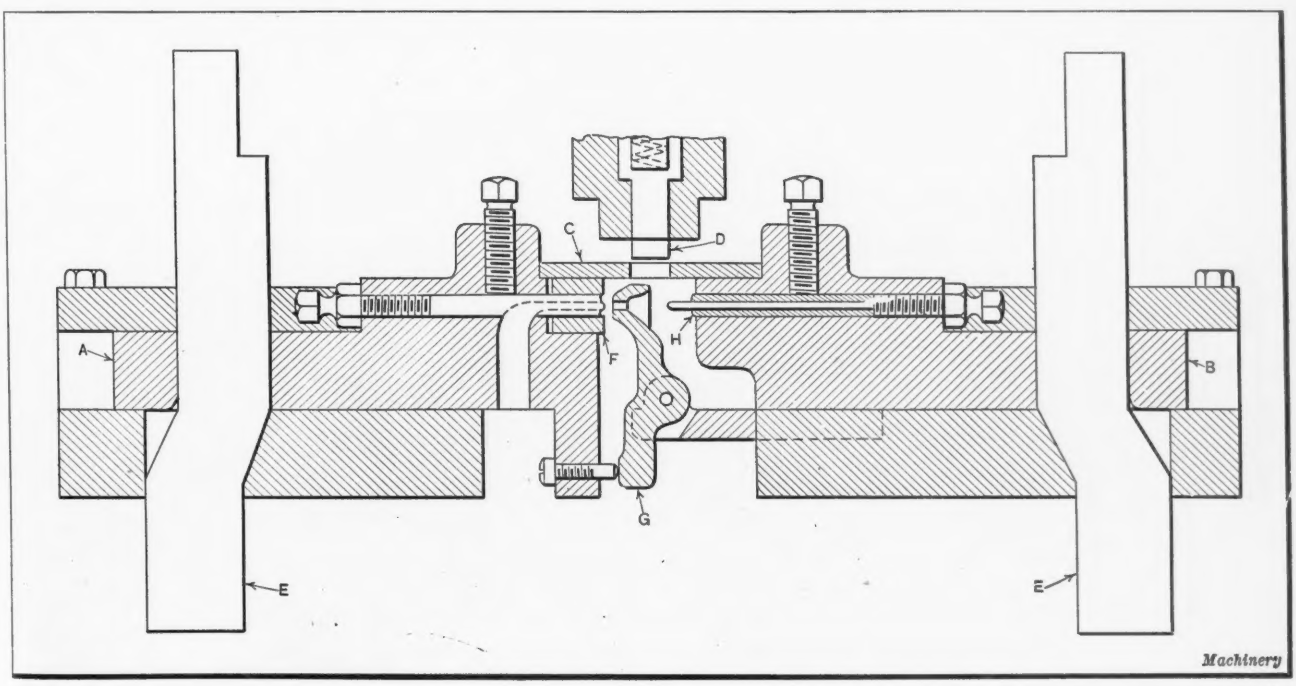


Fig. 4. Transverse Cross-section of Slides and Cams for operating the Piercing Punch and Die

NEW USE FOR AUTOMATIC MACHINES

By CHARLES W. LEE

In a certain shop a semi-automatic machine was made for a special line of work. This machine reduced production costs as compared with hand work for some types of this work, depending upon the shape, size, material, and other factors, all of which were well understood by the builder of the machine; but in some cases, hand work proved superior to the machine. As the limitations of the machine were thoroughly understood, the builder never tried to sell a machine for work for which it was not suited—partly because he was jealous of his reputation, and partly because he did not want to pay freight both ways.

Some time ago a customer ordered a machine for work that the builder knew could be done better by the old-fashioned hand method, and he therefore refused to fill the order; but the customer insisted upon buying a machine. He said he wanted it; he wanted it right now; he would pay cash for it and "no questions asked." Hence, a machine was duly shipped to him, paid for, and no complaints were heard in regard to it.

Some time later the builder of the machine, as was his custom, called upon the purchaser to ask whether the machine was working all right, and was told, "Oh, that machine! We never ran it. We stored it away on the top floor." Pressed for further explanations, the customer stated that his men had slackened their pace, and were not producing more than half a day's work as compared with pre-war days. So he told them that if they could not bring up production, he would buy one of these machines, which would throw most of the men out of a job. The implied answer had been "Go ahead and buy it. We will show that we can beat the machine." When the machine came in, they did quicken their pace, and, as both the builder and the customer knew that this machine was not particularly suited for the size of work handled in this shop, the machine was never installed.

Some expert in political economy may employ his spare hours to decide whether this machine was an economic loss or not, even though it was stored away on the top floor of the factory. The machine unquestionably aided in increasing production, and it accomplished this without throwing anybody out of a job, so that really both the employer and the employes gained their point.

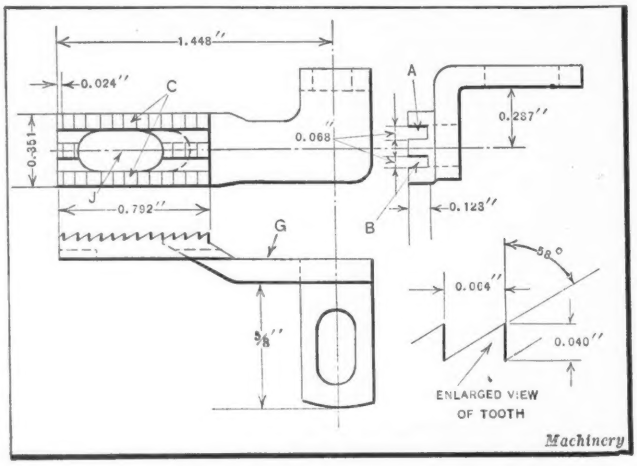


Fig. 1. Part milled in Fixture shown in Figs. 2 and 3

TWO-WAY MILLING FIXTURE

By C. J. DORER, Chief Tool Designer, White Sewing Machine Co., Cleveland, Ohio

The fixture illustrated in Figs. 2 and 3 is used to hold the piece shown in Fig. 1 while the slots *A* and *B* and the teeth *C* are being milled. It will be noted that the slots *A* and *B* are at right angles to the teeth. Ordinarily it would be necessary to make two settings of the work in order to perform the required milling operations. With the fixtures shown, however, only one setting or clamping of the work is required. Altogether three cuts are taken, two to finish the teeth *C* and one to produce the slots *A* and *B*.

The first cut is taken with the work-holding member of the fixture in the position shown in Fig. 2. The cutter *D* squares the end of the tooth portion of the work while cutter *E* cuts the teeth *C* and cutter *F* forms the surface at *G*. The second cut is taken with the work-holding fixture swung around or indexed 90 degrees to the position shown in Fig. 3, which permits cutters *H* to mill the slots *A* and *B*, Fig. 1, in the part. After these are cut, the fixture is turned back to the position shown in Fig. 2 and another cut is taken on teeth *C* to remove all burrs. Before this cut over the teeth is taken, shims are placed in the slot *J*, Fig. 1, to prevent the walls of the piece from collapsing under the pressure of the cutters.

The fixture is mounted on a Cincinnati milling machine, the end of the cutter-spindle being supported by the overhanging arm. The cutters, the part to be milled, and the center or pivoting point of the fixture, must be maintained in a definite relation to one another at all times. The relative positions of the cutters that mill the slots and the cutters that mill the teeth must be such that neither set of cutters will interfere with the work while the other set is in operation.

It is essential that the correct diameters be maintained on both sets of cutters in order to keep the correct relationship between the depth of the slots and the depth of the teeth. If this were not done, it would be necessary to raise or lower the table of the milling machine between cuts, which would be likely to affect the accuracy of the work. A skilled operator can produce thirty-seven pieces per hour with this equipment and still have time to operate other machines. All the cutters are form relieved. The cutter that forms the teeth also has clearance on the sides

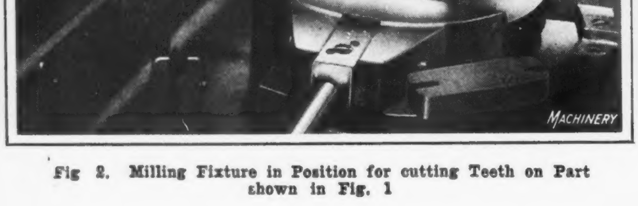


Fig 2. Milling Fixture in Position for cutting Teeth on Part shown in Fig. 1

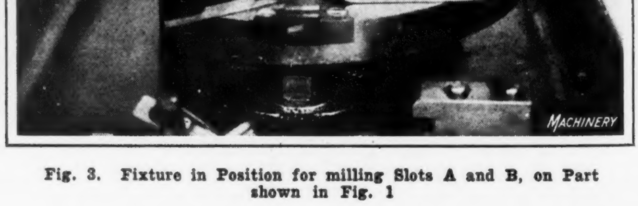


Fig. 3. Fixture in Position for milling Slots A and B, on Part shown in Fig. 1

so that the heel of the tooth will not drag and produce burrs on the sharp edges of the milled teeth.

Construction of Fixture

The plan view, Fig. 4, and the front view, Fig. 5, serve to show the construction of the fixture. Referring to Fig. 5, *J* is the cast-iron base on which the circular plate *K* is revolved when the work is indexed from the position shown in Fig. 2 to that shown in Fig. 3, or vice versa. Plate *K* is fitted with a locating block *L* against which the piece is clamped by jaw *M* which slides under the block *N*. Jaw *M* is actuated by a screw *O* (see also Fig. 4) which has a quick lead, a half turn being sufficient to release the work.

Plate *K* has a hardened steel stud *P* fastened to it, which is a sliding fit in bushing *Q*. Split nut *R*, which is threaded on stud *P*, serves to hold the plate and the base together. This nut may be locked in place by a set-screw *S*. Plate *K* is revolved by means of handle *T* which is pivoted on pin *U*. Handle *T* is provided with a hardened steel block *V* which engages a slot in the hardened block *W* attached to the base. When lever *T* is raised, plate *K* can be revolved to the position shown in Fig. 2. When the plate is in this position, the handle is lowered so that block *V* engages the slot in block *X*, Fig. 4, which is similar to block *W*, with which it was engaged in the previous position.

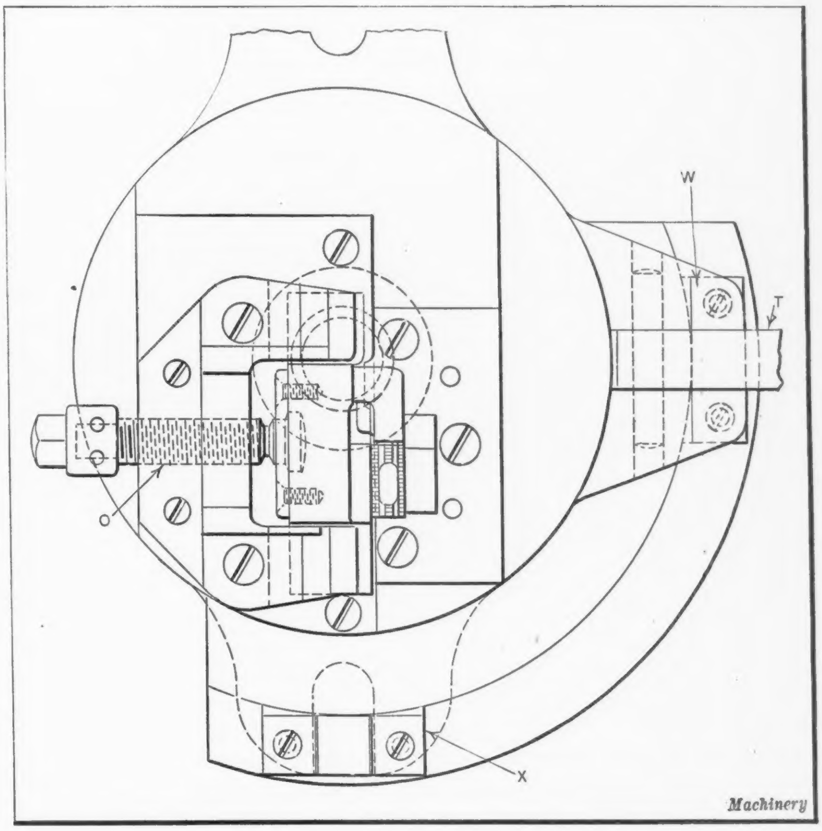


Fig. 4. Plan View of Fixture shown in Figs. 2 and 3

* * *

METAL STRAPS ON BOXES

The thickness of lumber required in the sides, top, and bottom of a nailed wooden box to give it adequate strength and serviceability without metal bindings may safely be reduced 20 to 40 per cent if the box is properly bound with metal straps. This conclusion is based on numerous observations of boxes in commercial service and on the results of tests made on some 2000 strapped wooden boxes by the Forest Products Laboratory of the U. S. Forest Service, Madison, Wis. Some of the general conclusions derived from this investigation are given in the following:

As a rule, straps should encircle the small dimensions of the box and act perpendicular to the grain in the sides, top, and bottom. If only one strap is used, it should be nailless and applied around the center of the box. When two straps are used, they should be applied one-sixth of the length of the box from the ends or around the extreme ends, depending on whether they are nailless or nailed. When three or more straps are used, the two outer straps should be applied as specified for two straps, and the others spaced equally between them. Three or more straps are recommended on relatively long boxes.

Nailless straps placed some distance from the ends of the box distribute the shocks which otherwise would be locally absorbed. This action relieves the direct pull on the nails and reduces splitting or breaking of the sides, top, and bottom. On boxes with adequate end cleats, nailless straps properly spaced along the length of the box might sometimes permit the use of thinner lumber than straps nailed around the extreme ends. Straps nailed around the extreme ends act somewhat as a cleat and give more rigidity to the box than nailless straps.

The same total cross-sectional area of strapping is recommended for two and three straps, and the same reduction in thickness of box material is permitted; but when one strap is used it should have 60 per cent of this total cross-sectional area, and a lesser reduction in thickness of lumber is permitted.

Tests made thus far indicate that the total cross-sectional area of one strap in square inches should equal approximately 1/1400, and of two or more straps 1/840, of the square root of twice the gross weight of the box and contents in pounds.

All strapping should be applied immediately before the box is ready for shipment and should be drawn sufficiently tight to sink into the edges of the box. Nailless straps should be applied at right angles to the edges of a box.

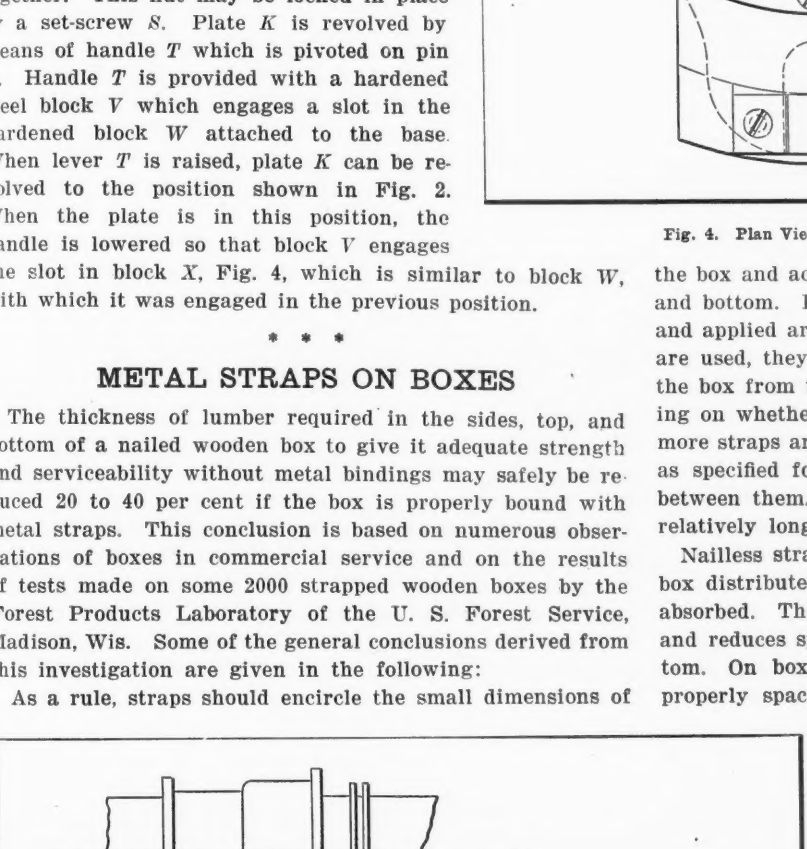


Fig. 5. Front View of Milling Fixture shown in Plan View in Fig. 4

CIRCULAR GRADUATING ON DIAL FACES

By HENRY B. FLINN

The common shop method of graduating the faces of dials is to employ an index-head on the milling machine, the machine and tool action, however, being really that of a shaper. This process at its best is necessarily slow because of the amount of hand work involved, and is little suited for quantity production. For doing this work on a production basis, a machine was sought with the following features: It must be capable of being accurately indexed; the tool action must be that of a planer or shaper; the design must permit indexing and machining either singly or in combination; and hand work must be eliminated as far as possible. It was found that the graduation of circular pieces, either on the periphery or on the face, could be rapidly and satisfactorily accomplished on the Fellows gear shaper. The periphery is easily graduated by a familiar method, but the circular graduating of faces by rolling or by marking with a single-tooth tool is of interest.

An application of the former method to production work and the latter to a single job in a tool-room will be described. The machine used in each instance was a Fellows helical gear shaper, the bed of which was raised 7½ inches from its normal position. A small faceplate was fastened to the work-spindle, and on this was mounted a Cincinnati index-head carrying a 6-inch three-jaw chuck, as shown in Fig. 1. The main spindle of the index-head was centralized with the work- and cutter-spindles. The lower worm-wheel and worm of the machine were meshed tightly and locked to prevent any rotary movement of the work-spindle, and the apron was also fastened in its seat.

Graduating by the Rolling Method

The piece graduated by rolling was a dial plate 6 inches in diameter, made from No. 16 B. & S. gage sheet brass. There were 360 graduations representing degrees radiating from the edge of the work. Each single-degree graduation was ¼ inch long; each fifth-degree graduation, ⅜ inch long; and each tenth-degree graduation ½ inch long. The graduating cutter was cone-shaped, as shown at *A* in Fig. 2, and had sixty teeth of the required lengths for the graduations. The tooth spacing of the cutter was the same as the desired spacing of the graduations on the dial, the diameter of the cutter at the base of the cone, being 1 inch. The face width of the cutter was ½ inch (the length of the longest graduation), and its cone radius, 3 inches to correspond with the radius of the dial. The base diameter of the cone and the cone radius being known, face angle *C* was easily determined to be 9 degrees 36 minutes. The cutter was placed in a standard holder and mounted in the cutter-spindle as shown in Fig. 1.

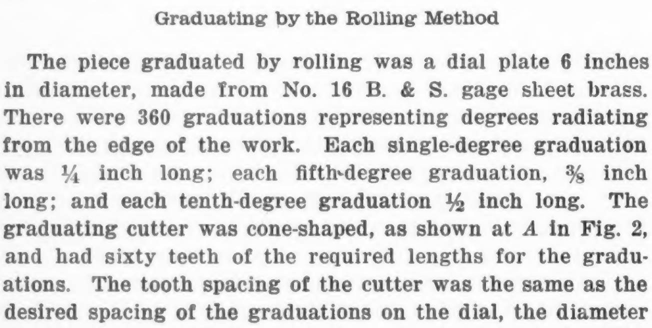


Fig. 1. Set-up of Fellows Gear Shaper for graduating Dial Faces by the Roll Method

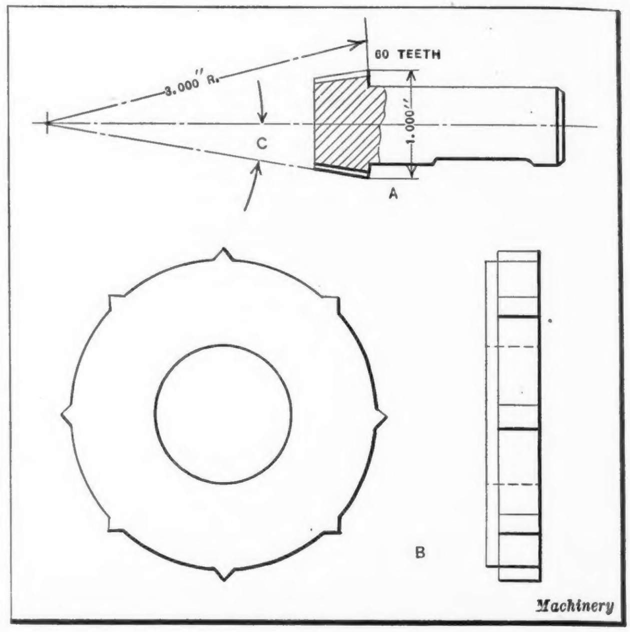


Fig. 2. (A) Cutter used for Roll Method of graduating; (B) Tool for Single-tooth Method

The dial was held between two cast-iron plates and located centrally on the chuck by means of a clamping screw, the body of which was a sliding fit in both the central hole of the dial and that of the rear supporting plate. This supporting plate had a shoulder by which it was held in the chuck jaws, and its position could not be altered after an alignment. The front clamping plate was backed by a pasteboard disk to prevent scratching the dial face. To remove the work, it was only necessary to take out the clamping screw. After the alignment of the supporting plate, the index-head was swiveled 9 degrees 36 minutes from the horizontal to bring the face of the work parallel with that of the cutter.

The feed and regular driving belts were removed from the machine, because the reciprocating movements of both the cutter-ram and the apron were not required. No action of the machine was necessary other than rotation of the cutter- and index-head spindles. In order to obtain a higher speed, the horizontal feed-rod was driven through a small pulley on its left end which was belted directly to a countershaft pulley. Power was transmitted to the index-head through the change-gears of the machine, sprockets, and a chain.

It was necessary, of course, to determine the correct relation between the rotation of the cutter and the work. The ratio between the number of teeth in the upper worm-wheel of the machine and the number of teeth in the worm-wheel of the index-head, taking into consideration the gears that transmit the motion from the upper to the lower part of the machine, was found to be 5 to 18. Substituting this ratio for that of 5 to 3 in the regular Fellows gear shaper formula for the computation of change-gears, and using this formula with 60 as the number of teeth in the cutter and 360 as the number of teeth in the gear, the proper gearing was found.

After a dial was placed in position and the height of the cutter-ram adjusted so that the lower edge of the cutter coincided with an inner circle stamped on the dial, the ram was locked in position. To bring the ram to the desired height, it was necessary to raise the guide case in the upper index-wheel of the machine by using several 1-inch ground blocks and clamp it by means of two screws. This could have been eliminated by using 8½-inch raising blocks under

the bed instead of the 7½-inch blocks previously mentioned. The machine was then started and the cutter brought into contact with the work by moving the saddle along the rail. With the pulley on the horizontal feed-rod running at 640 revolutions per minute and the cutter fed in to a depth of approximately 0.010 inch during three revolutions of the dial, it was possible to complete the operation in 3½ minutes, floor-to-floor time.

Single-tooth Tool Method

The dial for which the single-tooth tool was employed was 10 inches in diameter and had 300 graduations on its face. These graduations were of three different lengths, each tenth one being ⅝ inch long; each fifth one, ½ inch long; and the others, ⅜ inch long. For this operation, the special pulley was removed from the horizontal feed-rod and the main driving belt put back on its pulleys. Reciprocation of the cutter-ram and the apron were necessary, and for this reason the machine was driven in the customary way. The feed belt, however, was not used, because there was no rotation of the cutter-spindle and the work was indexed by hand. The straight guide case was let down and fastened as usual to the upper index-wheel. The index-head was used as before, but the work was held on an arbor instead of in a chuck, and the index head was set at zero. As the indexing of the work was done by hand, the sprocket was removed from the index-head and replaced by the regular index-plate, sector arms, and crank. The sector arms were then set correctly for obtaining the 300 divisions. The cutter used is shown at *B* in Fig. 2. This might have been of any diameter, thickness, and number of teeth, but the hole had to be 1¼ inches in diameter to fit the cutter-spindle nose.

After the cutter was mounted on the spindle and a tooth centered with the work, the connecting-rod of the machine was set for the push stroke. The length of the stroke was adjusted to 1½ inches, the lowest point of the cutter travel being ⅜ inch from the edge of the piece. The extra travel of the ram allowed the operator sufficient time to index the work while the machine was in motion. The machine was then started at a speed of 55 strokes per minute and the cutter fed into the work 0.004 inch, two successive strokes of the cutter being made on each graduation. During the cutting of a line the operator set the sector arms ahead, and as quickly as the second cut was completed and the apron started relieving for the upward stroke of the cutter, the index-crank was moved forward into its next position.

When the ⅜ inch graduations had been completed, the sector arms were set for indexing 30 divisions and the lowest point of the cutter travel set ½ inch from the outside of the work, to cut the ½-inch graduations. Owing to the distance through which it was necessary to turn the index-crank, it was impossible to index the work during the time the cutter was making a stroke. Therefore, the cutter was fed to depth by turning the crank on the saddle, taking the reading from the micrometer collar on the lead-screw of the machine. After the cut, the tool was backed out, the work indexed, and the tool again fed to depth. This cycle was continued until the completion of the ½-inch graduations.

When these graduations were finished, the lowest point of the cutter travel was extended to ⅝ inch below the edge of the piece, after which graduations of this length were produced in the same manner every 60 divisions. Indexing of the dividing-head by hand while the machine is in motion is only possible when there are a large number of graduations that require but a short turn of the index-crank. When this can be done, however, a great deal of time is saved, as will be realized from the fact that the three hundred ⅜-inch graduations were made in a little less than fifteen minutes. The entire time consumed, including the setting up, was about one hour.

SAFETY ATTACHMENT FOR DROP-HAMMER

In a certain cutlery manufacturing plant, a 75-pound drop-hammer is used to straighten springs, blades, and other parts blanked out on a punch press. This straightening operation is commonly referred to as "flattening," and is performed without heating the part. On the particular drop-hammer used, gravity is the only force employed to propel the hammer downward. The hammer is raised for each stroke by a jack incorporated in the machine. At first, the pieces to be straightened were placed on the lower die by hand and removed with a wooden stick, which the operator held in one hand. This, however, proved to be a rather hazardous operation, and was responsible for crushed fingers on several occasions. In order to eliminate this danger, the writer designed the safety device shown in the accompanying illustration.

This safety device is so constructed that the knock-off *A* will automatically push the operator's hands off the die as the hammer begins its downward stroke, and on the return stroke will sweep the straightened work from the die. In the illustration, the knock-off *A* is shown in the position it occupies when the hammer is in the extreme downward position at the end of its stroke. In this position the flattening or straightening has been accomplished, and the hammer, a section of which is shown at *B*, is about to ascend. During the upward movement of the hammer, knock-off *A* is drawn backward across the die, so that it sweeps the finished work into a box located below the surface of the die. When the hammer comes to rest in the extreme upward position, knock-off *A* is at the back of the die. The operator can then place another part on the lower die.

The bracket *C* is fastened to the base of the drop-hammer and serves as a bearing in which part *D* oscillates. Part *D* is supported at the top by a bracket *E* which is fastened to one of the uprights on which hammer *B* travels. Grooves *F* and *G* are cut in part *D*. These grooves are diametrically opposite each other, and are cut straight up to a predetermined distance above the face of the lower die. Beyond this point the grooves follow a helical path for a short distance, after which they continue straight until the top of part *D* is reached. This construction permits of adjusting the hammer to varying heights to strike a heavier or lighter blow without disturbing the functioning of the attachment. The lead and length of the helix section of grooves *F* and *G* determine the arc through which *D* is revolved or oscillated, and hence the distance knock-off *A* moves. Part *H* is fastened to the hammer *B*, and carries studs *J* which travel in the grooves in part *D*. This construction causes part *D* and the link *K* to oscillate during the rising and falling of the hammer.

An "in-and-out" movement is imparted to part *A* through link *K* and connecting-rod *L*. Cross-head *M* travels on guides *N*, which are held in brackets *O*, *P*, *Q*, and *R*. These brackets are fastened to the drop-hammer uprights. A sliding-fit dovetail joint holds parts *A* and *M* together. An interesting feature of the operation of the device is the method employed to raise the knock-off *A* slightly so that it will clear the work on its forward stroke, and then lower it so that it will sweep the flattened piece from the die on the return stroke. This is accomplished by means of cams *S* and *T* and pawl *U*. When cross-head *M* reaches the extreme rear position, the end of pawl *U* strikes cam *T*, causing the pawl to pivot on stud *Z* so that part *A* will be forced to slide upward at the dovetail joint. Part *A* then remains in the raised position during its forward movement so that it clears the work on the die. When it reaches the extreme forward position, the end of pawl *U* comes in contact with cam *S* and thus lowers part *A* so that it will sweep the flattened work from the die on its return movement.

The helix formed by the grooves on part *D* should be so located that the forward movement of knock-off *A* will take place just before the hammer falls, or at the beginning of the downward movement. With this arrangement, if the operator fails to withdraw his hands after placing the work on the die, they will be pushed out of harm's way by knock-off *A*. Part *A* is adjusted vertically by means of the set-screws *V* which bear on pawl *U*. A piece of leather *W* is fastened to part *A* to serve as a sweeper.

At the time the device was made, the writer suggested that a magazine with a shuttle arrangement be provided to feed the work to the die automatically. However, the production did not seem to warrant the additional outlay which this feature would necessitate, and was therefore not included. G. F. S.

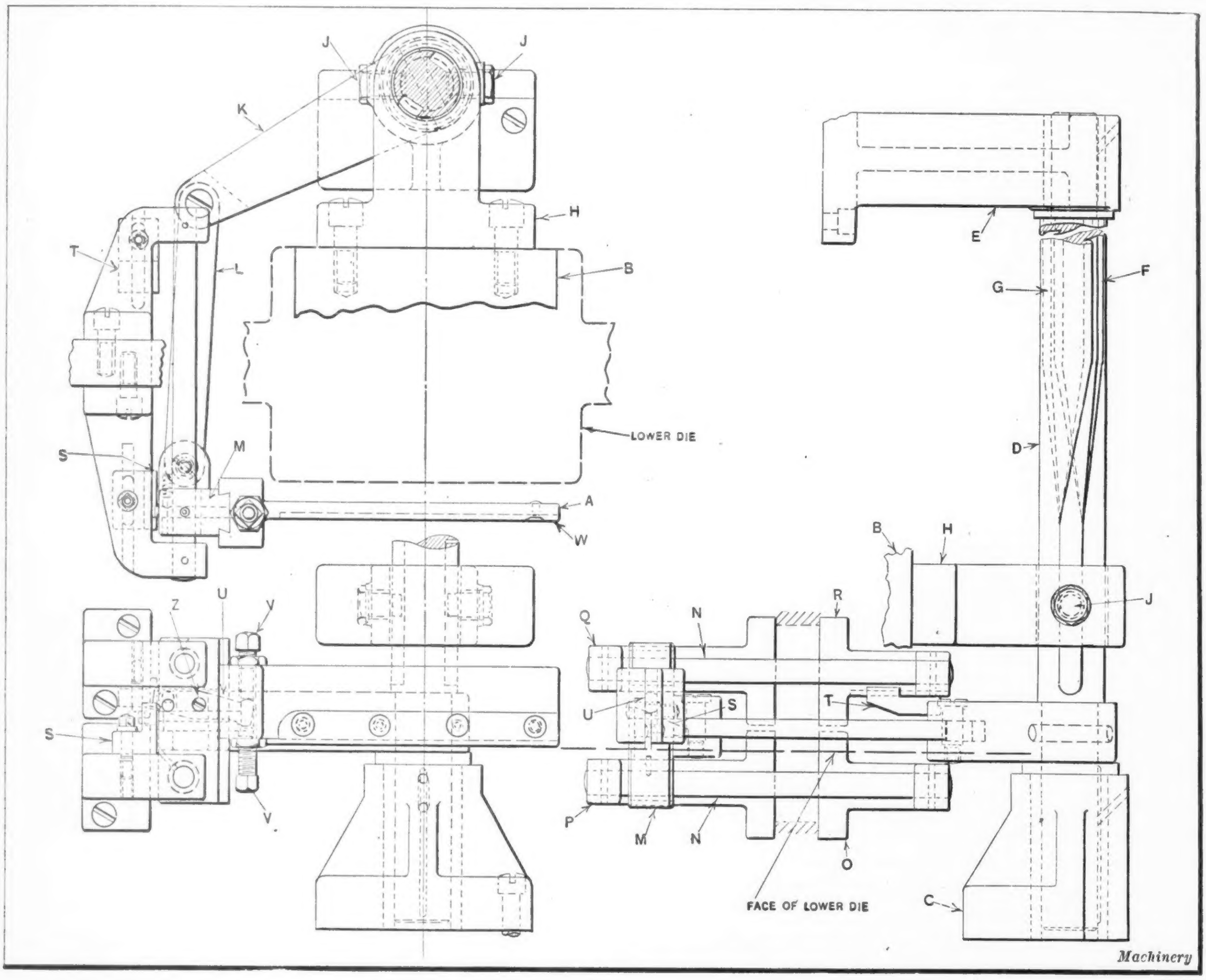
* * *

SEPARATING NICKEL-STEEL BARS FROM MIXED STOCK

By ARTHUR L. COLLINS

In a certain factory large quantities of nickel-steel parts were being heat-treated to meet very definite requirements as to physical properties. It was found, however, that a considerable percentage of the parts were failing under tests. Upon investigation, it developed that there was a lot of straight-carbon steel mixed in with the nickel steel, and of course the two kinds required entirely different heat-treatments. If the whole lot was treated for nickel steel, the straight-carbon steel parts would not, of course, give the desired results. It was therefore necessary to pick out the straight-carbon bars from the stock that had not been made up.

As there were thousands of bars, it would have been an endless task to make a chemical analysis of each. So the works laboratory was called upon to devise a method of separating the carbon-steel bars from the nickel-steel bars. The laboratory men soon had a method working which was extremely simple, yet effective. One drop of nitric acid having a specific gravity of 1.20 was placed on a spot on the bar from which the scale had been removed and allowed to work for ten seconds. A piece of white blotting paper was then pressed lightly on the spot to soak up the nitrates of iron and nickel (if present). Two drops of dimethylglyoxime solution were put on the nitrates on the blotting paper. If the color appeared red, the steel was known to contain nickel, but if it was brown, the test showed that the steel contained no nickel. This method was sensitive to 0.17 per cent nickel. The time required to make the test was about three minutes. This procedure resulted in saving large quantities of steel which otherwise would have been scrapped or sent back to the mill that supplied the material. In this particular case the steel mill was really responsible for the mix-up, and had the steel been shipped back to them, they would have had to separate the two kinds or else scrap the entire amount.



Drop-hammer Attachment, which pushes Operator's Hands from Die on Down Stroke and sweeps Work into Receptacle on Return Stroke

* * *

The chief advantages of grinding internal-combustion engine cylinders are, according to *Grits and Grinds*, as follows: (1) The accuracy is not affected by the springing of the cylinder walls; (2) the accuracy is not affected by hard or soft spots in the iron; (3) the accuracy is not affected by side ports, as in the two-cycle engine cylinder; (4) the wheel cuts with very little pressure; and (5) the grinding eliminates the necessity of lapping.

Leveling a Planer

By CHARLES OWEN LEWIS, Foreman of Planer Department, Lucas Machine Tool Co., Cleveland, Ohio

TO obtain accurately planed surfaces such as are required for machine tool beds, columns, platens, etc., the planer must be dead level. Of course, a casting can be seriously distorted by errors in clamping, but in the case of heavy work this can be avoided by removing all clamping straps when the finishing cuts are taken, stoppins being used to prevent the work from shifting on the planer table. By employing such methods in finishing well seasoned castings, a practically true flat surface will result, which will require a minimum amount of hand fitting or scraping. But how many planer hands know how to level a large planer? The writer ventures to say that there are very few who thoroughly understand this work. With the desire to assist those who may require information on this subject, a detailed description will be given of an accurate method of leveling up a planer.

Equipment Required for Leveling Operation

The planer should have a concrete foundation, and rest on screw-adjusting wedges, set three or four feet apart down each side, so that in leveling, any part can be easily raised or lowered. The tools needed for the leveling operation consist of a very accurate level, a straightedge finished on both edges and long enough to reach across the planer ways, and two cylinders of exactly the same diameter, preferably ground, which are laid in the ways to support the straightedge. With this equipment we are ready to proceed with the rough leveling, the purpose of which is to take out any twists in the planer bed.

Rough Leveling

First run the planer table as far forward as possible; then place the cylinders in the ways, one on each side, directly under the cross-rail; on these set the straightedge and level. Now raise the low side of the planer by means of the wedge under that point until it is level. Then move the level back until it is even with the end of the housing and adjust this point until it is level; move it farther down the ways until it is over the next pair of wedges, then level and proceed to the next and so on down to the end.

Now run the planer table as far back as it will go so as to expose the other half of the bed, and level in the same way, starting in the center and working toward the end. The back end of the planer, which was leveled first is now probably slightly out of level due to the twisting of the bed while leveling the front half. It is therefore necessary to check up by leveling all over again, the same as before. After this is done, the planer bed will be free from all twists and dead level crossways for its entire length.

To level a planer entirely by the bed, might be misleading, as the bed itself could be made perfectly level and yet when the heavy table traversed it, it might be distorted sufficiently to cause the planed surface of the work to be thrown out of true. It is the line, or plane, of the cut that should be level, not the planer bed, so to level the planer lengthwise use is made of what is termed the "running level."

The Running Level

Set the planer table so that the front end is even with the end of the bed, then place the level in a lengthwise position on the table at a point under the cutting tools. Make note of the position of the air bubble with reference to the graduations. Now move the planer table backward until the level is even with the back end of the housings and again inspect the level. If the bubble has changed position, the planer is not level.

Do not adjust the wedges yet, but move the table farther back until the level is over the next pair of wedges. Inspect the level again and move the table as before until the level is again over a pair of wedges. Continue doing this until the end of the table is flush with the back end of the bed. Now by comparing the readings of the level at the different positions it can be told whether the table made a gradual rise or descent, or rose and fell intermittently, that is, with a wave-like motion. The wedges should now be adjusted with a view to overcoming any irregularities thus revealed.

Second Leveling Operation

Next return the table to its original position, and repeat the whole operation. Continue leveling in this way until the bubble does not change position at any point. Now with the back end of the table flush with the back end of the bed, place the level in position again under the cutting tools and note the position of the bubble. It is not imperative that the level read exactly the same as it did before, because it is now at a different point on the table and the table may not be perfectly true. Simply note the position of the bubble and proceed to level the front half of the planer in the same way that the back half was leveled. When this is accomplished, check up the back half again to see if any slight change has occurred.

Crosswise Leveling

The planer is now perfectly level lengthwise, so the next step is to get it level crosswise by means of the running level. Place the planer table so that the front end is flush with the end of the bed, and set the level in a crosswise position under the cutting tools. Note the position of the bubble and move the table backward until the level comes over a pair of wedges, and again read the level. If the bubble has changed position, adjust the wedge on the low side until the bubble returns to its original position.

Now move the table again until the level is over the next pair of wedges, and adjust as before. When the back end of the planer is level, the front end should be leveled in the same manner. It is a wise plan to check up the lengthwise leveling again, as some little alteration may be necessary because of the effect of crosswise leveling.

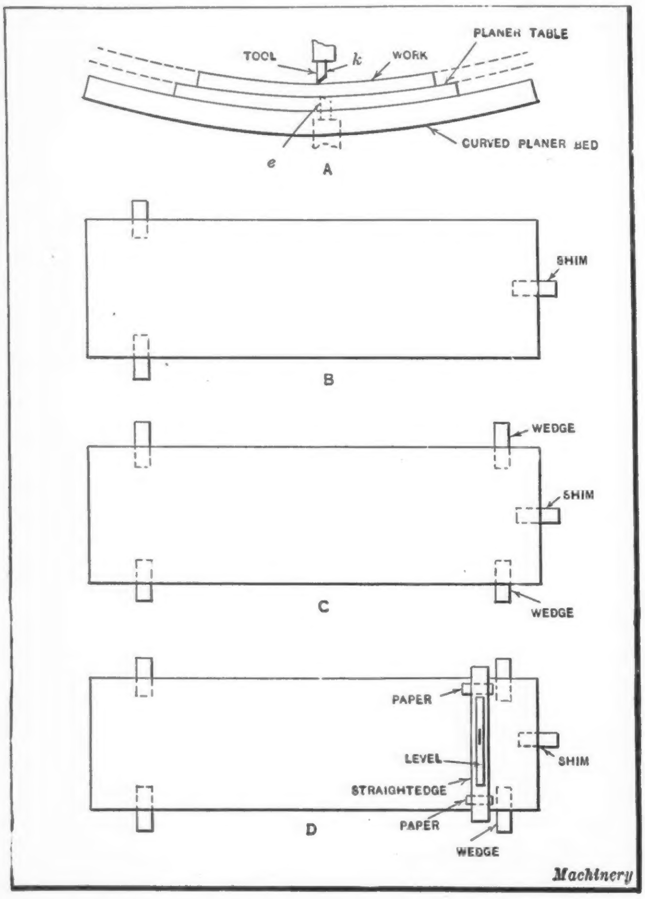
The planer will now be dead level both lengthwise and crosswise, and the only thing remaining to be done is to see that all the wedges are supporting their share of the load. This can be done as follows: Place the level on the planer table identically the same as for crosswise leveling, and tighten the wedge on one side until the bubble moves very slightly; then tighten the other wedge until the bubble returns to its original position. Repeat this operation over each pair of wedges, and in this way it will be known that they are all tight. A planer leveled in this way will turn out work which is absolutely flat, if care is exercised in setting up the job.

Some castings, because of their construction, will be found to be high in the center when they come to be scraped, even if planed on a planer that is perfectly level. This can be overcome by raising the ends of the planer slightly. This is good practice in such cases, as a large bed can be scraped down much quicker if the surface plate bears

strongly on the ends. If the center of the planer is lower than the ends, the finished surface will be concave, and if the center is higher than the ends, a convex surface will result. The effect is that of a planer bed traveling on the arc of a large circle, as in turning and boring. If the tool is on the outside of the circle, as indicated at *e* in the diagram *A*, the work will be convex, and if on the inside as at *k* it will be concave.

Setting up the Work

A few points on setting up machine tool beds, etc., for planing may be of interest. In planing beds of the box type construction, which are very stiff, the work should be supported at three points, as indicated at *B*. Pieces of gib steel, say, ¼ by 1 by 4 inches, make excellent packing for this class of work. As the work is supported only at three



Methods of leveling Work on Planer Table

points it is not twisted, but retains its true shape while being planed. It should also be set on the same three points for scraping. Rectangular pieces, which have previously been rough-planed, and which are not stiff enough to set on three points for finishing, such as horizontal boring mill and milling machine tables, can be supported at five or seven points, according to the length.

This should be done as follows: First set the casting on three pieces of ¼-inch gib steel, as indicated at *B*. Now procure some slightly tapered wedges, say cast-iron pieces about 1 inch wide by 4 inches long that have a taper of about 0.005 inch and are ¼-inch thick in the center of the tapered sides. Next slip two of these wedges under the corners of the casting at the end that has only one support as shown at *C*. Just press them in lightly with the fingers until they feel tight. If either one is too loose, a piece of paper can be placed under it to make it tight.

Now take a very fine level, one that is graduated so that the bubble will move one graduation, or about ⅛ inch, when a cigarette paper is placed under one end. Place this crosswise of the casting, on the end where the wedges were inserted. If the level is rather short, it is better to set it on a straightedge that has a piece of paper under each end so that it will not rock on the center. (See diagram *D*.)

Next read the level and notice the exact position the bubble takes in relation to the graduations. Now with a light hammer, tap one of the taper wedges until the bubble in the level moves very slightly; then tap the other wedge until the bubble returns to its original position. The casting is now resting on five points without any distortion. If the work is long enough to warrant it, an additional wedge may be placed under the center of each side, putting the level crosswise of the center and proceeding as before. This is the seven-point set-up.

There are some parts of machine tools, like the platens on horizontal boring machines, etc., on which the top has to be finish-planed after the bottom has been scraped to fit the saddle. Of course it is necessary that the top be planed absolutely parallel with the scraped surface. On work of this kind it is advisable to have a fixture or set of blocks that can be clamped to the planer table and a finishing cut taken over them. When the work is placed on these blocks or fixture, the side that is then planed will be perfectly parallel with the scraped surface. When planing the blocks or fixture, the planer cross-rail should be raised sufficiently to allow the work to pass through without having to change the height of the cross-rail.

* * *

STANDARDIZATION OF ABBREVIATIONS AND SYMBOLS

The American Engineering Standards Committee held a conference February 13 for the consideration of the standardization of abbreviations and of the symbols used in engineering equations and formulas. The object of the conference was to determine whether unification of engineering abbreviations and symbols should be undertaken, and the scope of such work. The need for the standardization of abbreviations is emphasized by the existing confusion resulting from the variety of symbols used to designate the same thing, and the multiplicity of meanings of the same symbol applied to different things. The expression "pounds per square inch" may be represented by at least half a dozen abbreviations. Some British journals use "h. p." for high potential, whereas in the United States this symbol is generally understood to mean horsepower. Whether or not the letters "h. p." should be capitalized or hyphenated is a matter upon which the styles used by different journals and authors are not agreed. The symbol (") may mean inches, seconds, or a quotation. Great confusion necessarily occurs when several symbols are used to designate the same thing, as in the cases mentioned.

* * *

INFORMATION ON STEEL TREATING

The American Society for Steel Treating has decided to prepare, as a service to its members, loose-leaf data sheets relating to steel treating. These sheets will consist of tables, charts, and information for those interested in steel and its treatment. It is proposed to have these data sheets ultimately form a handbook that will have the same relationship to the steel-treating industry as the Society of Automotive Engineers' handbook has to the automotive industry. These fields are too specialized for extreme detailed treatment in regular engineering handbooks, which naturally must cover, in a broad manner, the entire machine-building or engineering field; and while the regular standard handbooks give a great deal of information relating to steel and its treatment, the American Society for Steel Treating believes that for the specialist in the field a handbook devoted entirely to the problems met with by its members will be of considerable value.

CALCULATIONS FOR DOVETAIL SLOTS

By EDWARD HELLER

Many of the mathematical problems with which the shop man or the draftsman has to deal, are of a nature that are not, generally speaking, difficult to solve. Nevertheless, in some cases there are certain intermediate steps that must not be overlooked or else the problem will appear difficult and even incapable of being solved. A problem of this nature is frequently encountered in laying out the outline of a dovetail slot when the top and the bottom corners are rounded, as shown in Fig. 1. In practically all cases, the known dimensions are W, w, A, and the two radii B and C. The angle to be found is x.

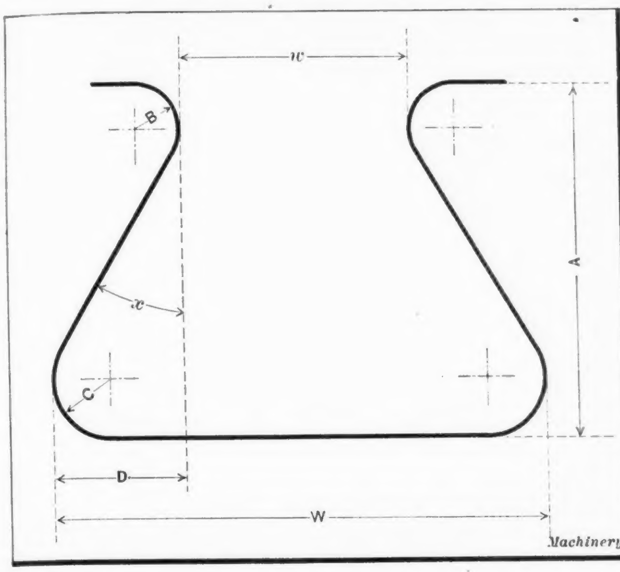


Fig. 1. Outline of Dovetail Slot with Rounded Corners

The procedure is to deal with one side of the slot only, so that it is necessary to find D which equals $(W - w) \div 2$. The conditions of the problem will alter the exact procedure followed in its solution, there being three distinct cases as follows: Case 1: When D is greater than $B+C$; Case 2: When D equals $B+C$; and Case 3: When D is less than $B+C$.

The formulas and an example covering each of these cases follow.

Case 1

Referring to the first diagram in Fig. 2,

$E = A - (B + C)$ $\qquad F = D - (B + C)$

$\text{Tan } y = F \div E$ $\qquad G = \sqrt{E^2 + F^2}$

The value of H in each case is found in the following manner:

$B : H = C : (G - H)$ Then $HC + BH = BG$

and

$$H = \frac{BG}{B + C} \qquad \text{Also} \qquad \text{Sin } z = \frac{B}{H}$$

and

$$x = y + z$$

The conditions of Case 1 will be satisfied if we let $A = 3$ inches, $B = 3/8$ inch, $C = 1/2$ inch, and $D = 1$ inch. Substituting these values in the foregoing equations,

$$E = 3 - (0.375 + 0.50) = 2.125 \text{ inches}$$

$$F = 1 - (0.375 + 0.50) = 0.125 \text{ inch}$$

$$\text{Tan } y = 0.125 \div 2.125 = 0.05882$$

Then

$$y = 3 \text{ degrees } 21 \text{ minutes } 59 \text{ seconds}$$

$$G = \sqrt{2.125^2 + 0.125^2} = 2.1286 \text{ inches}$$

$$H = \frac{0.375 \times 2.1286}{0.375 + 0.50} = 0.9123 \text{ inch}$$

$$\text{Sin } z = 0.375 \div 0.9123 = 0.41105$$

$$z = 24 \text{ degrees } 16 \text{ minutes } 15 \text{ seconds}$$

Adding y and z,

$$x = 27 \text{ degrees } 38 \text{ minutes } 14 \text{ seconds}$$

Case 2

The solution of the problem when the conditions place it under Case 2, is the simplest of the three. Referring to the second diagram in Fig. 2,

$$E = A - (B + C) \qquad H = \frac{BE}{B + C}$$

$$\text{Sin } z = B \div H \qquad x = z$$

The conditions will be satisfied if we let $A = 3$ inches, $B = 3/8$ inch, $C = 1/2$ inch, and $D = 7/8$ inch. Substituting these values in the equations for Case 2,

$$E = 3 - (0.375 + 0.50) = 2.125 \text{ inches}$$

$$H = \frac{0.375 \times 2.125}{0.375 + 0.50} = 0.9107 \text{ inch}$$

$$\text{Sin } z = 0.375 \div 0.9107 = 0.41177$$

$$x = z = 24 \text{ degrees } 19 \text{ minutes}$$

Case 3

The diagram for Case 3 in Fig. 2 indicates that the solution of the problem when these conditions obtain is similar to that of Case 1. The same procedure is followed as in Case 1 and the same equations are derived, with the exception of the two following, and these two differ only in that the values are reversed in order.

$$F = (B + C) - D \text{ and } x = z - y$$

The conditions of this case will be satisfied if we let $A = 3$ inches, $B = 3/8$ inch $C = 1/2$ inch, and $D = 3/4$ inch. Then by substituting the values in the equations for E, G, H, y, and z, given under Case 1, and in the two foregoing equations, we have:

$$E = 3 - (0.375 + 0.50) = 2.125 \text{ inches}$$

$$F = (0.375 + 0.50) - 0.750 = 0.125 \text{ inch}$$

$$\text{Tan } y = 0.125 \div 2.125 = 0.05882$$

$$y = 3 \text{ degrees } 21 \text{ minutes } 59 \text{ seconds}$$

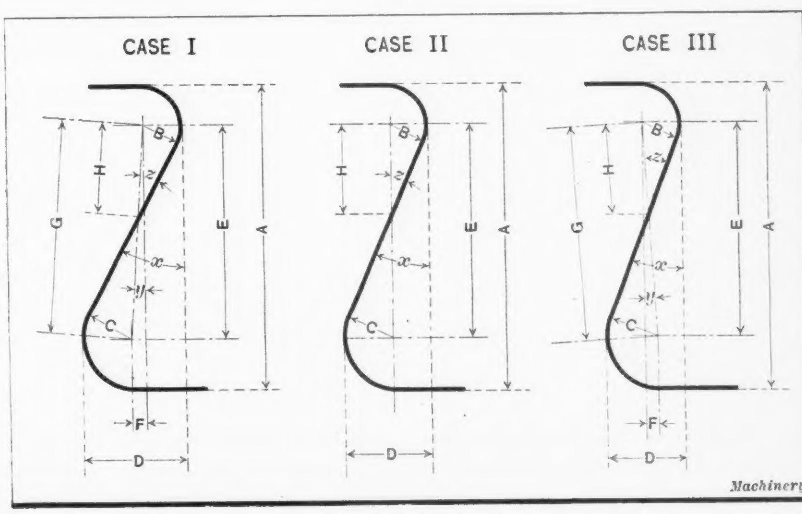


Fig. 2. Diagrams used in calculating Angularity of Dovetail Slot

$$G = \sqrt{2.125^2 + 0.125^2} = 2.1286 \text{ inches}$$

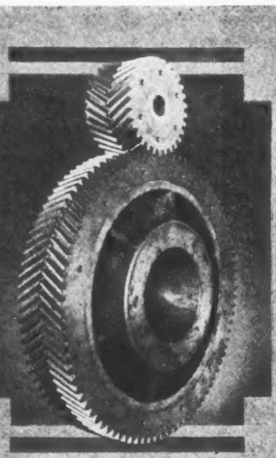
$$H = \frac{0.375 \times 2.1286}{0.375 + 0.50} = 0.9123 \text{ inch}$$

$$\text{Sin } z = 0.375 \div 0.9123 = 0.41105$$

$$z = 24 \text{ degrees } 16 \text{ minutes } 15 \text{ seconds}$$

Subtracting y from z,

$$x = 20 \text{ degrees } 54 \text{ minutes } 16 \text{ seconds}$$



Cutting Double Helical or Herringbone Gears

By FRANKLIN D. JONES

Application of Hobbing Machines of Single- and Double-hob Types—First of Two Articles

DOUBLE helical or herringbone gears may be produced either by hobbing, planing (using either a gear shaper or planer) or milling. In hobbing gears of this type, an ordinary machine designed for cutting spur and helical gears may be used, or the work may be done on a special machine intended particularly for herringbone gears. If the planing process is employed, the teeth may be formed by a generating method, or a machine of the templet or form-copying type may be used. The two general methods of milling are by using end-mills and by using cutters of the disk type.

Herringbone gears may be formed of one solid piece or of two half sections. When there are two sections these may be cut separately, the same as two single helical gears, and afterward bolted together so that the teeth of each section are either in alignment or staggered, as may be required. When herringbone gears are made of one solid piece, the right- and left-hand teeth may also be directly opposite or offset an amount equal to one-half the circular pitch. These solid gears usually have a clearance space between the right- and left-hand tooth sections to provide room for the cutter, but the amount of clearance required varies for different methods of cutting; in fact, the method may be such that the clearance space is eliminated, the teeth extending across the gear without a groove at the center.

Herringbone gears, except very large sizes, are usually cut on an ordinary hobbing machine designed for spur and helical gears. When this type of machine is used, the gear may be cut by finishing the teeth of one side and then turning the gear over, or it may be held in one position for cutting both the right- and left-hand sections. Fig. 1 shows a hobbing machine cutting a herringbone gear. A single-threaded right-hand hob is being used.

According to a rule given in the article on generating helical gears in February MACHINERY, when a hob is the same hand as the gear to be cut, the hob is inclined from a horizontal position an amount equal to the difference between the helix angle of the gear (as measured from the axis) and the angle of the hob, as measured from a plane perpendicular to its axis (the "end angle"). Since the hob illustrated in Fig. 1 is right-hand and is cutting the right-hand section of the gear, it is set according to the rule just given. On the contrary, when a right-hand hob is used for cutting gear teeth which incline to the left (when the gear is viewed from an endwise position) the hob spindle is inclined from the horizontal an amount equal to the sum of the gear and hob angles, instead of the difference between these angles.

Herringbone gears are usually cut to an angle of 23 degrees. This angle is selected primarily to allow successive pinion teeth of gearing having an adequate face width, to overlap properly when the gearing is in mesh. This face width is usually about six times the circular pitch. According to another rule, the minimum width of the active face should equal 16 divided by the diametral pitch.

In using a single-threaded hob for cutting herringbone gears having an angle of, say, 23 degrees, it is necessary, of course, to incline the hob, since its angle is less than that of the gear. Sometimes a multiple-threaded hob is used; in that case, the hob angle is made to agree with the gear, and the hob spindle is set at right angles to the axis of the gear. An example of the use of a multiple-threaded hob corresponding to the angle of the gear being cut is illustrated in Fig. 2, which shows a Newton machine hobbing a herringbone pinion. It will be noted from the illustration that the hob spindle is set at right angles to the axis of the pinion.

Several examples of hobbing herringbone gears are illustrated in Figs. 3 to 5, inclusive. The herringbone pinions (Fig. 3) are formed integral with their

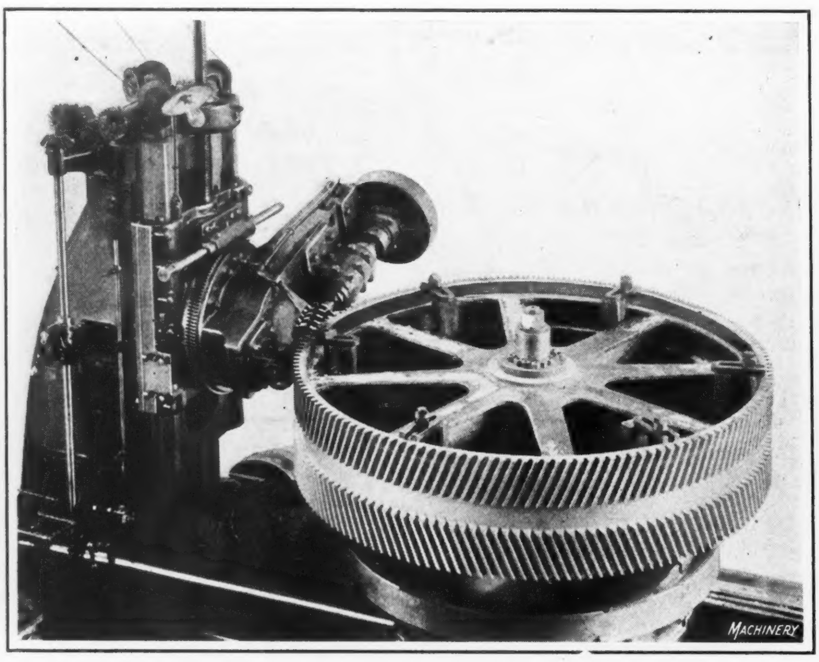


Fig. 1. Cutting a Double Helical or Herringbone Gear on a Hobbing Machine

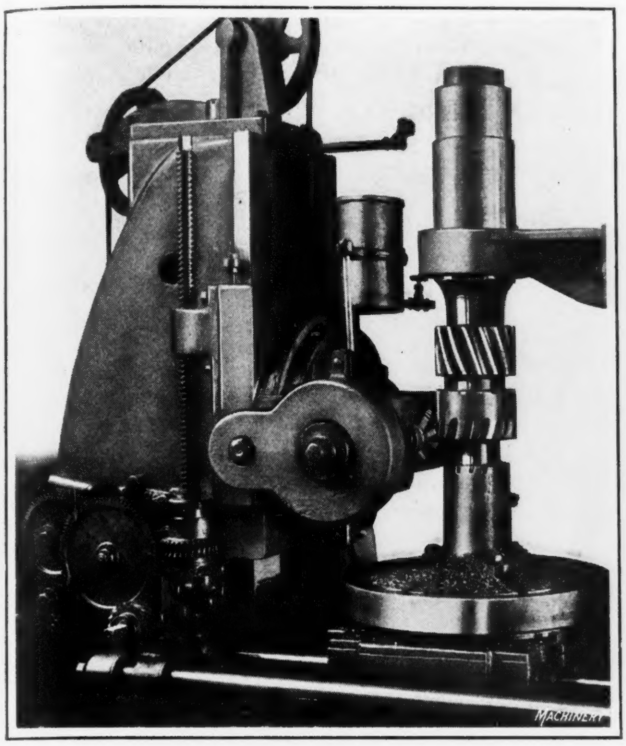


Fig. 2. Using Multiple-threaded Hob set at Right Angles to Axis of Gear

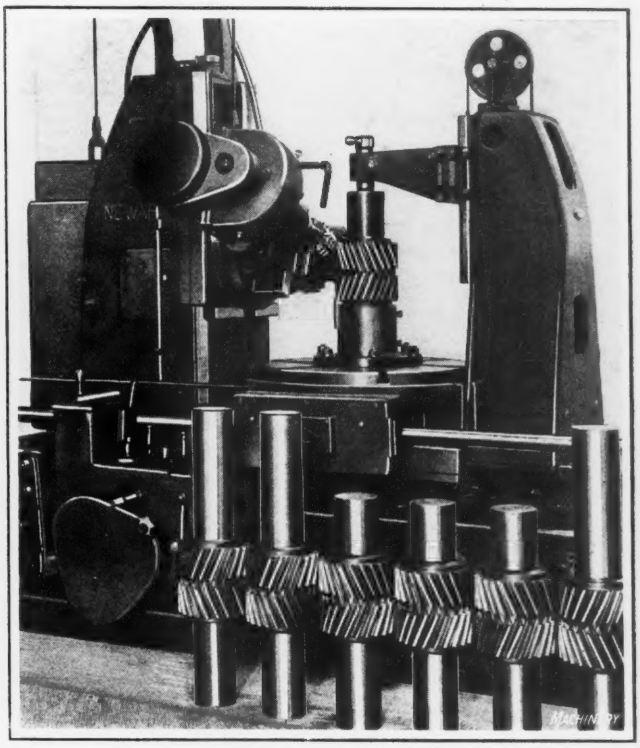


Fig. 3. Cutting Herringbone Pinions that are Integral with their Shafts

shafts, and are used for rolling mills. These pinions have 22 teeth which are staggered, the teeth on one side being opposite the spaces on the other. A cast-iron flanged sleeve bolted to the work-table is used for holding the lower end of the pinion, and the long shaft projects into a pocket in the work spindle. The gears are all cut on one side, and are then turned upside down for cutting the other side. A small finger or gage projecting above the cast-iron sleeve is used for locating the pinions after one side has been cut, in order to have the teeth on the opposite side offset or staggered properly and uniformly for each pinion. The pitch diameter of these pinions is 8 inches, and the angle 23 degrees 33 minutes. The normal diametral pitch is 3, and the face width 7⅝ inches. This work is done on a hobbing machine made by the Newark Gear Cutting Machine Co.

Fig. 4 illustrates the cutting of herringbone gears formed of two sections, which are bolted together after cutting the teeth. This view shows a Gould & Eberhardt machine at the plant of Foote Bros. Gear & Machine Co., Chicago, Ill. These gears are made of steel, and have 75 teeth of 2½ diametral pitch, a 36-degree angle, and a face width of 3 inches. The cutting of a fairly large herringbone gear is shown in Fig. 1. This gear has a pitch diameter of approximately 85 inches, a face width of 21 inches, and a tooth angle of 29 degrees 34 minutes. The work was done in the plant of the Farrel Foundry & Machine Co., Ansonia, Conn.

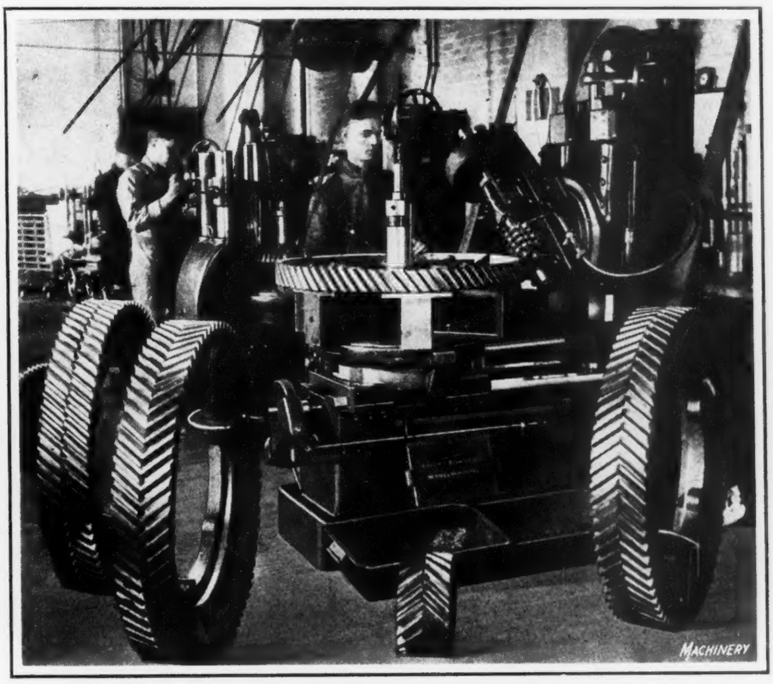


Fig. 4. Cutting Herringbone Gears formed of Two Sections

An interesting example of herringbone gear work is illustrated in Fig. 5, which shows another Gould & Eberhardt machine. This is one of the herringbone gears for reduction gearing used in conjunction with a steam turbine. These gears are made from steel forgings, and are 96 inches in diameter. Both sides of the gear are cut without changing its position on the machine, the hob being set at the correct angle first for one side and then for the other. One reason that herringbone gears are sometimes cut by first finishing the lower half and then turning the gear over is to keep the hob slide in a low and more rigid position on the column.

The application of a method developed by the Newark Gear Cutting Machine Co., for which a patent is pending, is illustrated in Fig. 6, which shows the hobbing of a cast iron herringbone gear having 65 teeth of 4 diametral pitch. A single-threaded hob of small diameter is used, and this hob is designed to generate more perfectly formed teeth than are obtained with a multiple-threaded hob set in the zero position or at right angles to the axis of the work. It is claimed that this single-threaded hob set at the proper angle gives a full generating action. The hob is made of special form to secure the desired involute and pressure angle in the plane of rotation of the gear.

This method is said to be rapid and accurate, and the gears operate satisfactorily just as they are cut by the machine, it being unnecessary to employ a running-in process using sand or other abrasive. The width of the gap between the

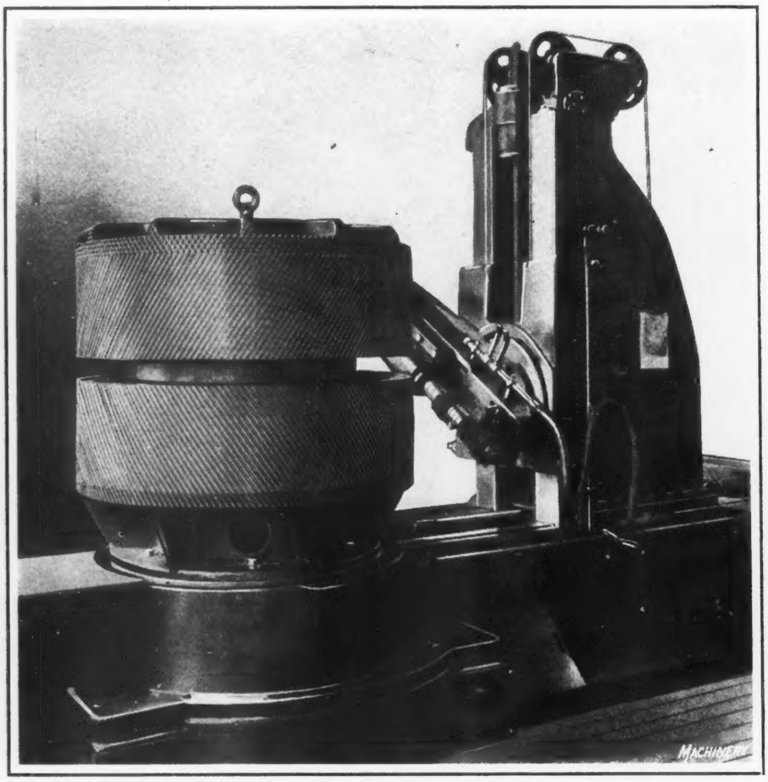


Fig. 5. Cutting Herringbone Gears for Steam Turbine Transmission

right- and left-hand sections is made just as narrow as the width specified by the American Gear Manufacturers' Association for multiple-threaded hobs set in a zero position.

Proportions of Herringbone Gear Teeth

In designing herringbone gears, all calculations for pitch, helix angle, addendum, and dedendum are based ordinarily upon the diametral pitch in the plane of rotation of the gear. This method greatly simplifies the calculations, as compared with those required for helical gearing connecting shafts that are not parallel. In the latter case it is necessary to consider the normal pitch, since this must always be equal on both gear and pinion, whereas the circular pitch (measured in a plane perpendicular to the axis) may vary considerably. With herringbone gears the designer may disregard the normal pitch and proceed on a basis of diametral pitch obtained the same as for spur gears, or he may use the circular pitch.

In cutting herringbone gears, however, the gear tooth calipers are set according to the normal thickness, and the hob (if designed to be set at an angle) is proportioned according to the normal pitch, the same as for other forms of helical gearing. If the axis of the gear and hob are at right angles (as for the Wuest method) the axial pitch of the hob equals the circular pitch of the gear.

Assume that the gear is of 2 diametral pitch. Then the circular pitch equals $3.1416 \div 2 = 1.5708$, the same as for a spur gear, but the normal circular pitch equals the circular pitch times the cosine of the helix angle. If this angle is 23 degrees, then the normal circular pitch equals $1.5708 \times 0.9205 = 1.4459$; hence, the normal tooth thickness along the pitch surface equals $1.4459 \div 2 = 0.7229$ inch.

Table 2, obtained from Gould & Eberhardt, gives normal pitches and tooth thicknesses for various diametral pitches, as well as other data for use in cutting and designing herringbone gears. This table is based on a helix angle of 23 degrees and a pressure angle of 20 degrees in the plane of rotation of the gear. The addendum is equal to $0.8 \div$ diametral pitch; the dedendum equals $1 \div$ diametral pitch; and the full depth of the tooth equals $1.8 \div$ diametral pitch.

Herringbone Gear Blank Diameters

The outside diameter of a herringbone gear blank under normal conditions is found by adding 1.6 to the number of teeth and dividing the sum by the diametral pitch. However, if the pinion is small, the diameter is increased to avoid undercutting of the teeth. In this case, the outside diameter is first calculated in the usual manner; then an amount (depending upon the number of teeth and the diametral pitch) is added to the diameter and a corresponding amount is subtracted from the gear, thus avoiding any change in the center distance. Table 1, representing recommended practice of the American Gear Manufacturers' Association, shows the amounts to add to the pinion and subtract from the gear. This table covers pinions having seventeen teeth or less, and diametral pitches from 1 to 10. If two enlarged pinions must be run together, the center distance has to be increased by one-half the sum of the enlargement. Some manufacturers enlarge pinions having less than twenty-five teeth. In setting up the machine for cutting an enlarged pinion or a reduced gear, the hob is set according to the helix angle at the true pitch circle, the enlargement or reduction of the blank not being considered.

Setting Gear after Cutting One Side

The teeth on each side of a herringbone gear may occupy the same relative positions or be staggered, as previously mentioned. The diagram Fig. 7 illustrates a simple method (obtained from Gould & Eberhardt) of locating the gear relative to the hob after cutting one side. When one side is finished, a square is used, as indicated by the dot-and-dash lines, to transfer or project the top edges of the finished tooth to the uncut side of the gear blank. In other words, marks are made on the uncut side corresponding in location

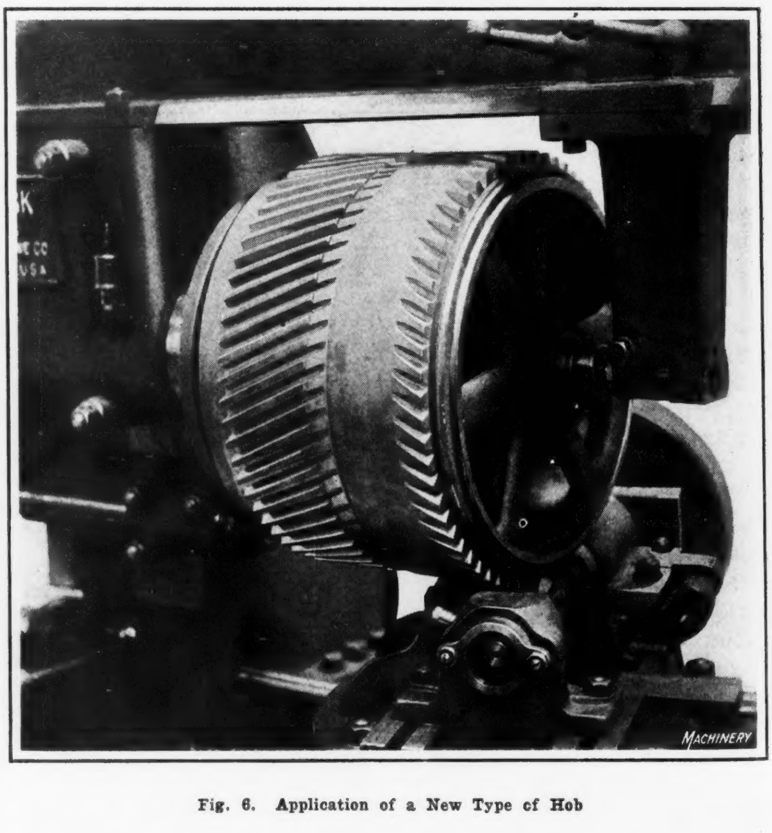


Fig. 6. Application of a New Type of Hob

TABLE 1. ENLARGEMENT FOR HERRINGBONE PINIONS

No. of Teeth	Diametral Pitch 10	8	6	5	4	3½	3	2½	2	1¾	1½	1¼	1
7	0.1181	0.1478	0.1976	0.2364	0.2954	0.3382	0.3938	0.4726	0.5906	0.6762	0.7882	0.9450	1.1810
8	0.1064	0.1330	0.1782	0.2128	0.2662	0.3046	0.3548	0.4258	0.5322	0.6094	0.7102	0.8514	1.0640
9	0.0947	0.1184	0.1586	0.1894	0.2368	0.2712	0.3158	0.3790	0.4736	0.5424	0.6322	0.7578	0.9471
10	0.0830	0.1038	0.1392	0.1662	0.2076	0.2378	0.2768	0.3322	0.4152	0.4756	0.5542	0.6642	0.8302
11	0.0713	0.0892	0.1196	0.1428	0.1784	0.2044	0.2378	0.2854	0.3568	0.4088	0.4762	0.5706	0.7132
12	0.0596	0.0746	0.1002	0.1194	0.1492	0.1710	0.1988	0.2386	0.2982	0.3420	0.3982	0.4772	0.5962
13	0.0479	0.0600	0.0806	0.0958	0.1200	0.1376	0.1598	0.1918	0.2398	0.2752	0.3202	0.3836	0.4792
14	0.0362	0.0454	0.0612	0.0726	0.0906	0.1042	0.1208	0.1450	0.1812	0.2082	0.2424	0.2900	0.3623
15	0.0245	0.0308	0.0416	0.0492	0.0614	0.0708	0.0818	0.0982	0.1228	0.1414	0.1644	0.1964	0.2453
16	0.0128	0.0162	0.0222	0.0258	0.0322	0.0374	0.0428	0.0514	0.0642	0.0746	0.0864	0.1028	0.1283
17	0.0011	0.0016	0.0026	0.0024	0.0028	0.0040	0.0038	0.0046	0.0058	0.0078	0.0084	0.0092	0.0113

Machinery

to a finished tooth on the opposite side. Then, by disengaging the clutch on the index driving shaft, the work-table and gear blank can be rotated by hand in order to center the tooth marks in relation to the hob. Next, the machine is started, and a slight notch is cut all around the blank, after which the machine is stopped to check the location of the notches relative to the tooth marks. If additional adjustment is necessary, this can be made by moving the hob, using the cutter-adjusting device. If the teeth are to be staggered, the same procedure is followed except that a tooth space is centered on the uncut side instead of marks representing a tooth.

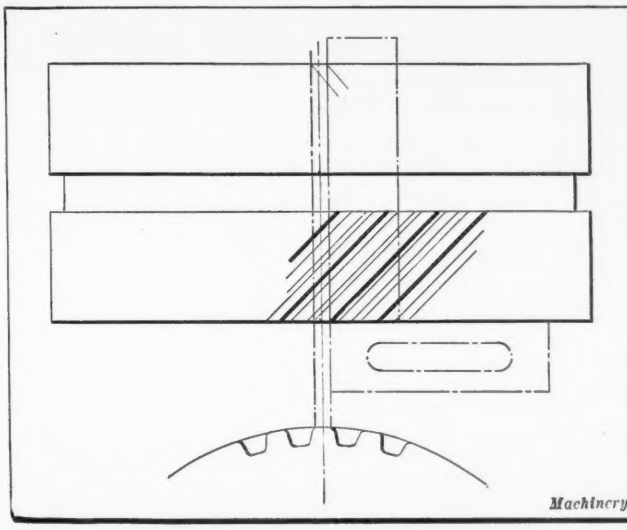


Fig. 7. Method of locating Gear Blank Relative to Hob after cutting One Side

Cutting Both Sections of Gear Simultaneously

Some types of hobbing machines designed for cutting herringbone gears are provided with two hobs for cutting both sides at the same time. For instance, two hobs are used in conjunction with the Wuest method (originated in Switzerland). These hobs are located on opposite sides of the gear blank, and one cuts downward while the other cuts upward. Helical teeth are formed as the result of an accelerating or retarding motion imparted to the work-table and gear blank.

Multiple-threaded hobs set at right angles to the axis of the gear are used, and these are so located relative to each other as to form staggered teeth. As these teeth are offset an amount equal to one-half the circular pitch, the tooth spaces of one side serve as clearance spaces for the hob cutting the opposite side when the inner ends of the teeth are being finished; consequently herringbone gears cut by this method do not require the wide clearance groove that is necessary for hobbing teeth that are in alignment.

Fig. 9 shows a large machine of special design used at the plant of the Falk Corporation, Milwaukee, Wis., for cutting herringbone gears according to the Wuest method. This machine has a capacity for diameters up to 16 feet 3 inches, face widths up to 6 feet, and diametral pitches up to ¾, although larger pitches have been cut. The massive heads or columns seen on opposite sides of the gear each support a hob. These heads are adjusted by power along the horizontal bed, to suit the diameter of the gear. Very accurate lead-screws are used for this adjustment, and the heads are located by graduations on the bed, in conjunction with graduated dials on the lead-screws.

Each hob is carried by a counterweighted slide located on the vertical face of the head. While one hob feeds from the top of the gear downward, the other is feeding upward from the bottom toward the center; at the same time the work-table is given a slow rotary motion to generate teeth of the required helix angle. Change-gears in conjunction

TABLE 2. PROPORTIONS OF HERRINGBONE GEAR TEETH

Diametral Pitch	Circular Pitch	Normal Circular Pitch	Thickness of Tooth on Pitch Line	Addendum	Dedendum	Clearance	Working Depth of Tooth	Total Height of Tooth
1	3.14159	2.89183	1.44591	0.80000	1.00000	0.20000	1.60000	1.80000
1.25	2.51327	2.31346	1.15673	0.64000	0.80000	0.16000	1.28000	1.44000
1.50	2.09439	1.92788	0.96394	0.53333	0.66666	0.13333	1.06666	1.19999
1.75	1.79519	1.65247	0.82624	0.45714	0.57142	0.11428	0.91428	1.02856
2	1.57080	1.44592	0.72296	0.40000	0.50000	0.10000	0.80000	0.90000
2.25	1.39262	1.28190	0.64095	0.35555	0.44444	0.08889	0.71110	0.79999
2.50	1.25664	1.15674	0.57837	0.32000	0.40000	0.08000	0.64000	0.72000
2.75	1.14240	1.05158	0.52579	0.29090	0.36363	0.07273	0.58180	0.65453
3	1.04720	0.96394	0.48197	0.26667	0.33333	0.06666	0.53334	0.60000
3.50	0.89760	0.82624	0.41312	0.22857	0.28571	0.05714	0.45714	0.51428
4	0.78540	0.72296	0.36148	0.20000	0.25000	0.05000	0.40000	0.45000
5	0.62832	0.57837	0.28918	0.16000	0.20000	0.04000	0.32000	0.36000
6	0.52360	0.48197	0.24098	0.13333	0.16666	0.03333	0.26666	0.29999
7	0.44880	0.41312	0.20656	0.11428	0.14285	0.02857	0.22856	0.25713
8	0.39270	0.36148	0.18074	0.10000	0.12500	0.02500	0.20000	0.22500
9	0.34906	0.32131	0.16065	0.08889	0.11111	0.02222	0.17778	0.20000
10	0.31416	0.28918	0.14459	0.08000	0.10000	0.02000	0.16000	0.18000
12	0.26180	0.24099	0.12049	0.06667	0.08333	0.01666	0.13334	0.15000

Machinery

with a differential mechanism, control the relation between the feeding movement of the hobs and the rotary motion of the work-table, in accordance with the helix angle and the number of teeth.

Each hob is adjustable relative to the work for cutting the teeth of each section in the proper alignment. A preliminary adjustment is first made for roughing; then, before taking the finishing cut, a gage is used to determine whether or not additional adjustment is necessary. Hobs having stepped teeth for breaking up chips have been used successfully for the roughing cut on this machine.

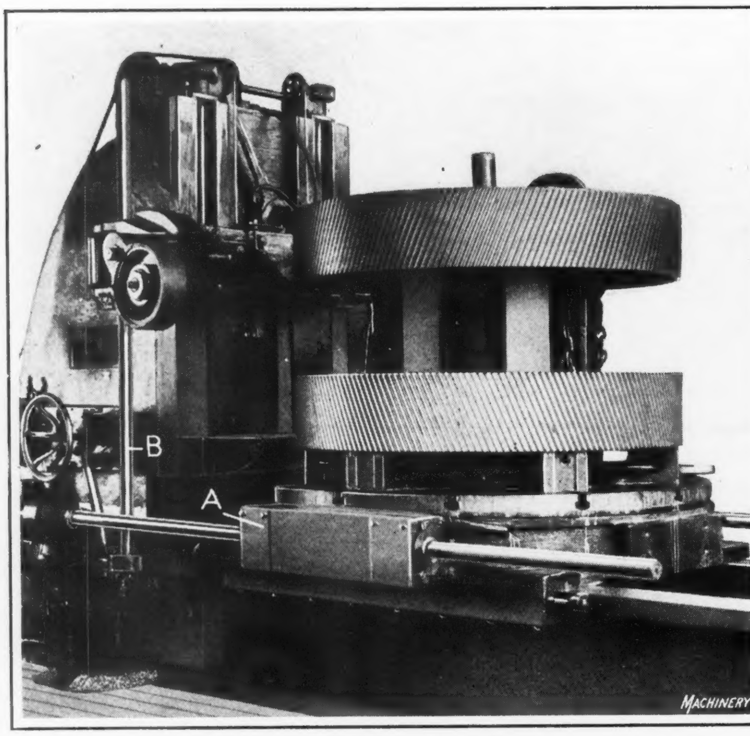


Fig. 8. Large Machine of the Type having Two Hobs for cutting Both Sections of a Herringbone Gear simultaneously

Machines having Two Hobs Located on Same Side of Blank

Two hobs located on the same side of the blank are used for cutting herringbone gears by the hobbing method developed by the Fawcus Machine Co., Pittsburg, Pa. The arrangement of the hobs may be seen in Fig. 10, which shows a 48-inch machine. These hobs operate simultaneously on both sections of the gear. Right- and left-hand multiple-threaded hobs are used, and these rotate in opposite directions. One hob begins at the top of the blank and feeds down to the clearance groove at the center, while the lower hob begins at this groove and feeds down to the bottom of the blank.

As both of these hobs are located on the same side of the blank, and are cutting teeth that incline in opposite directions, the helical teeth cannot be generated by imparting an accelerating or retarding motion to the work-table, as is done with an ordinary helical gear-hobbing machine. In order to obtain helix angles of opposite inclination, a differential speed mechanism is employed to retard the speed of one hob and increase that of the other, relative to the feeding motion and at such a rate that the required helix angle is generated on both sides of the gear.

Fig. 8 shows a 144-inch machine cutting a large ship transmission gear. The two hobs are mounted on a vertical slide. The bottom hob is not adjustable on this slide, but the top one is carried by an auxiliary slide which can be adjusted vertically for varying the distance between the two hobs in accordance with the face width of the gear. As each hob feeds downward across the face of the gear blank, it cuts tooth grooves corresponding to its own helix angle, which is 23 degrees. The upper hob is retarded and the lower one accelerated just the right amount for generating teeth on the right- and left-hand sections of the gear having the 23-degree helix angle. The differential gearing through which this compensating movement is transmitted is located at the lower end of the vertical splined shafts *B*, which drive the hobs from each side of the machine. These differential gears are controlled by the saddle feed, and they serve to retard the right-hand hob an amount equivalent to the acceleration of the left-hand hob. This saddle feed, in turn, is controlled by change-gears.

Motion is transmitted to the work-table of this machine through two splined shafts located on each side. These

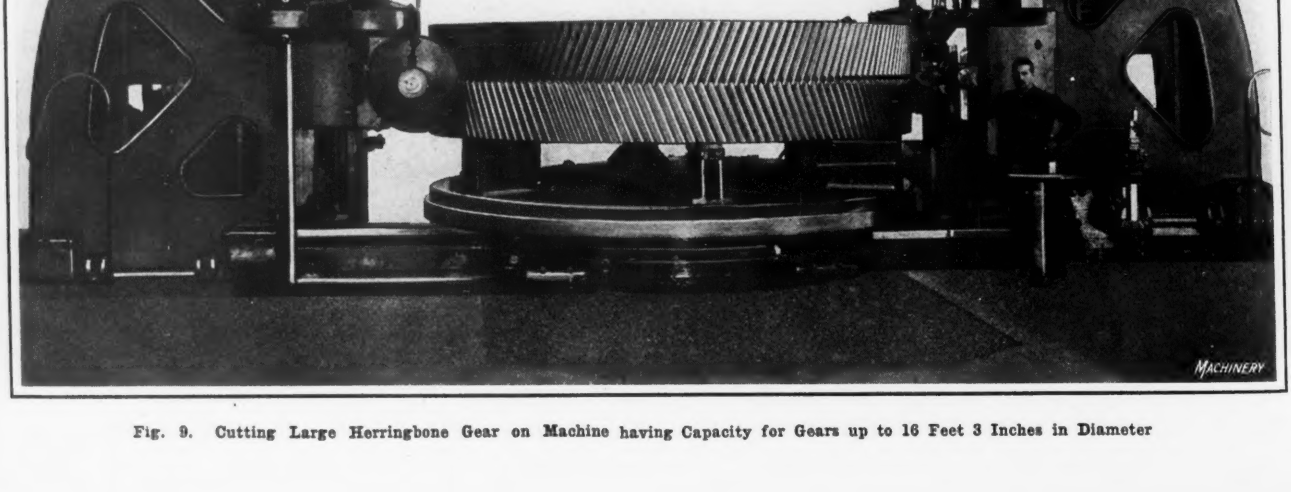


Fig. 9. Cutting Large Herringbone Gear on Machine having Capacity for Gears up to 16 Feet 3 Inches in Diameter

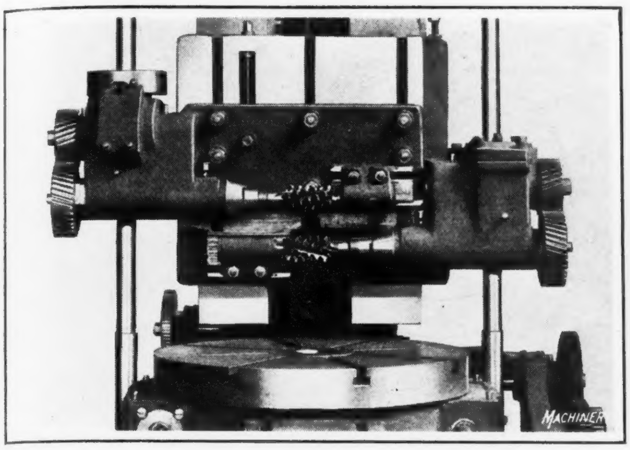


Fig. 10. Machine equipped with Two Hobs for cutting Right-and Left-hand Sections of a Herringbone Gear simultaneously

shafts drive right- and left-hand worms, enclosed at *A*, on opposite sides of the table and engaging a large worm-gear on the table spindle. The hobs used on these machines have three, four, five, or six threads, and since the helix angle is 23 degrees for all of the hobs, the number of threads determines the hob diameter for each pitch. These pitches are restricted to standard diametral pitches, and one pair of right- and left-hand hobs will cut any number of teeth of that pitch. The hobs are the same as ordinary worm-gear hobs.

The teeth on the herringbone gears cut on these machines converge at the center or occupy the same relative position on each side, instead of being staggered. These teeth are of short addendum involute form, having a 20-degree pressure angle and an addendum equal to 0.8 divided by the diametral pitch. The pitch diameters of the blanks are calculated in the same way as for diametral pitch spur gears. The hobbing type of machine is used for cutting gears of one diametral pitch and smaller. For larger pitches, gear planers are used, as explained in the next installment of this series.

* * *

MOISTURE-RESISTANT COATINGS FOR WOOD

Shrinking and swelling and internal stresses that cause warping and checking are brought about in wood by changes in the moisture content. Such changes are occurring continually when wood is exposed to changing atmospheric conditions, and the only way to prevent or retard them is to protect the wood from the air with some moisture-resistant finish or coating. In order to determine the protection against moisture afforded by various coatings, a series of tests is being conducted by the U. S. Forest Service, at the Forest Products Laboratory, Madison, Wis. No coating or finish that is entirely moisture-proof has yet been discovered, but several have been found to be very effective.

Linseed oil, although it is probably recommended more frequently than most of the other materials for moisture-proofing wood, was found in the absorption tests to be quite ineffective. Five coats of hot oil followed by two coats of floor wax failed to give any great protection. Oil paints form a film over wood, which is very durable even in exterior locations. Laboratory tests show, however, that such a film, although it may be continuous, does not prevent moisture changes in the wood. Graphite paints and spar varnish are about as effective as the ordinary oil paints with the heavier pigments.

Among the best coverings were found to be aluminum-leaf coating developed at the Forest Products Laboratory particularly for the protection of airplane propellers. Such a coating can best be applied to large unbroken surfaces. Some asphalt and pitch paints also have high moisture-resisting properties.

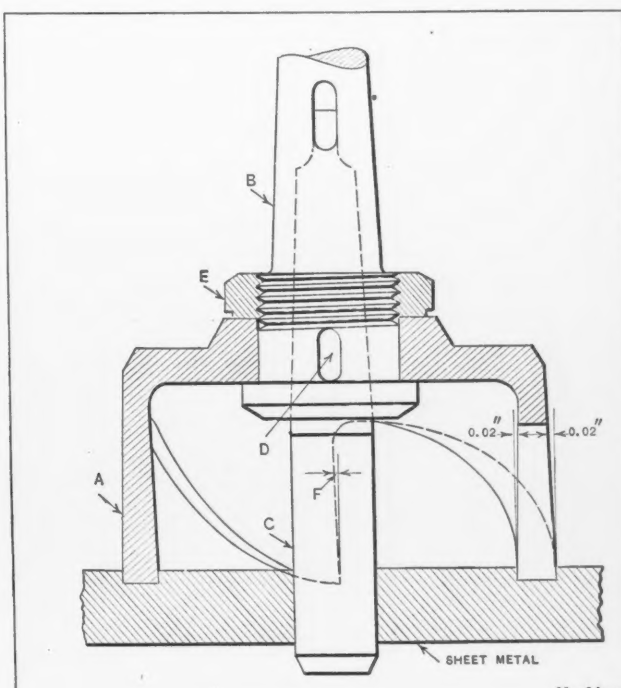
TREPANNING TOOL FOR CUTTING HOLES IN METAL PLATES

By JOE V. ROMIG

Boilermakers and sheet-metal workers are often called upon to cut large holes in metal plates. When the holes are too large to be drilled with an ordinary twist drill, a series of small holes can be drilled in a circle to remove most of the metal, after which the rough edges can be finished to a true circle. However, this method consumes considerable time. For such holes a trepanning type of tool can be used to advantage. A tool of this type designed to be used in a drill press is shown in the accompanying illustration. This tool has three or four teeth which are formed by removing sections of metal on the cylindrical part of a cup-shaped piece of tool steel *A*. The shank *B* is turned to size from a tough alloy steel. Usually, the shank is tapered to fit the spindle of the largest drill press available, and is threaded at the lower end, which terminates in a flange, as shown.

The shank is drilled and reamed to receive the tapered end of the pilot *C*, which is made of tool steel. A knock-out hole is provided to facilitate the removal of the pilot. The cutter *A* is made of tool steel, and the side walls are turned to a taper as shown. For small and medium sized tools, a taper of about 0.02 inch on each side of the teeth will usually give the best results. The closed end of the cup-shaped cutter is bored to fit the lower part of the shank *B*, and is held in place on the shank by a key *D*. A threaded nut *E* clamps the cutter against the flange on the lower end of shank B. The cutter is gashed for either three or four teeth, as desired; usually three teeth give satisfactory results.

A very slight rake, as indicated by angle *F*, may be given to the front side of the teeth. If the rake angle is too great, however, the tool will have a tendency to dig in. For the same reason the clearance angle on the sides of the teeth should also be small. When the cutter is sharpened it is ground only on the front side of the teeth. The height of each tooth should be accurately measured and care taken to keep all the teeth of a uniform height. With this type of tool one shank can be used for cutters of various diameters. Pilots of different diameters can also be employed. In using the tool, a hole is first drilled through the sheet metal to receive the pilot *C*.



Tool for cutting Large Holes in Metal Plates

PROPER LOCATION OF DOWELS

By FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co.

In attaching locating blocks or other accurately located units on a jig or fixture, dowels are generally used. Frequently the positions of the dowels, as specified by the designer on the drawing, are not the best possible. Two examples of the use of dowels are shown in Fig. 1 at *A* and *B*. They are used in attaching locating blocks on a fixture, the blocks being held down by fillister-head screws. The position of the dowels at *A* only permits them to be placed apart a distance *C*. This location is not the best one, for they can be placed much further apart, as indicated at *B*, where they have a center-to-center distance *D*. The farther the dowels may be separated, the greater the accuracy obtainable. None but an inexperienced designer would space the dowels as indicated by the first example, but drawings of this sort are frequently seen.

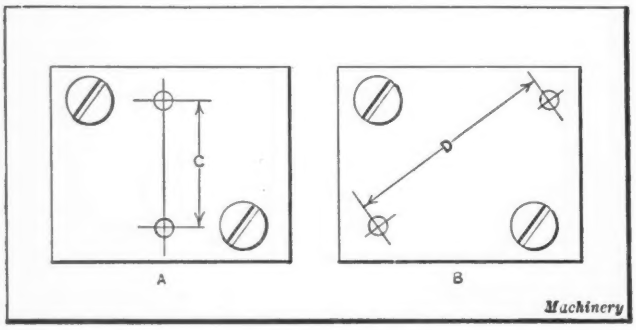


Fig. 1. Two Methods of locating Dowels, the One at B being Preferable

At *A* in Fig. 2 is illustrated a case in which the dowels are placed too near the edges of the plate located by their use. The dowels are likely to break out the thin wall of metal between them and the edges of the block, or distort the piece where they are driven in. Dimension *C* should always be at least equal to the diameter of the dowel, and a little more than this is preferable. This is clearly illustrated in example *B*, where dimensions *D* are somewhat greater than the dowel diameter. The sectional views illustrate the importance of this point in design.

Cases Where Only One Dowel is Needed

It is not always necessary to use two dowels in locating a part, as one is sufficient in certain cases. In Fig. 3, at *A*, the bottom of a circular block *C* fits a recess *D* in the part to which the block is attached, and is held in place by three fillister-head screws and one dowel. As plate *C* fits the recess, it need only be prevented from turning, and

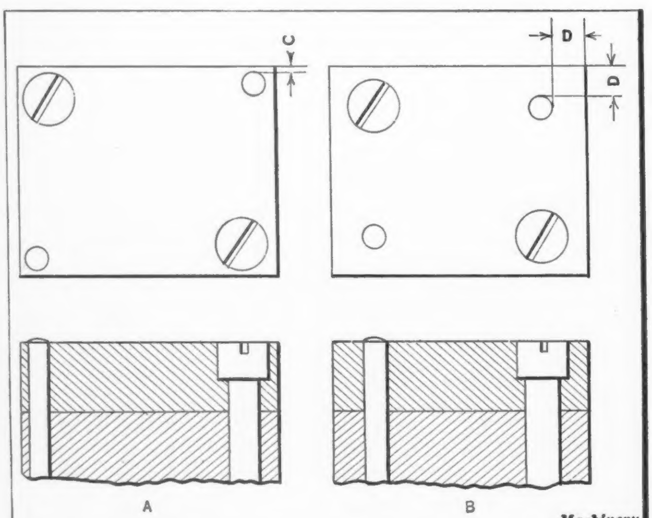


Fig. 2. Diagrams showing how far Dowels should be located from the Edges of a Part

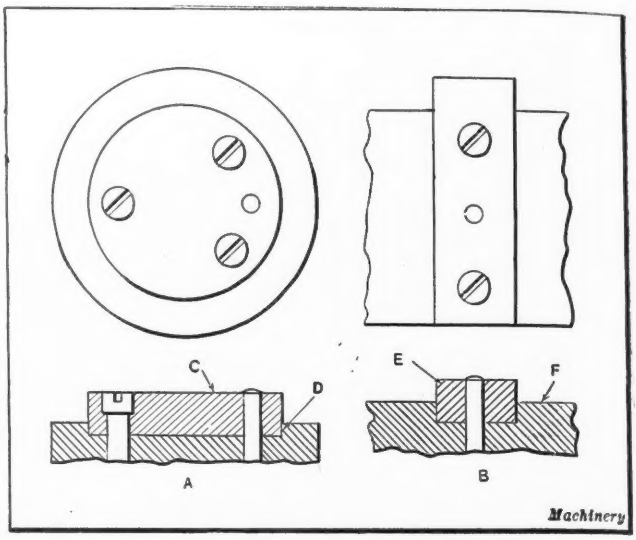


Fig. 3. Examples showing Cases where One Dowel is Sufficient to hold the Attached Part in the Proper Location

therefore a single dowel answers the purpose. In this example, plate *C* is plain, but it might easily have a locating groove that would need to be placed in a certain relation to some other part on the fixture, in which case a dowel would be necessary.

In the example illustrated at *B*, a locating plate *E* fits a slot in part *F*. Plate *E* is also fastened in place by means of fillister-head screws, while a single dowel is employed to establish the correct position on the part to which the plate is attached. Occasionally a part is made with a tongue that fits a groove or slot in the work, and in cases of this kind a single dowel also is sufficient.

When a locating block is so placed that it must resist considerable pressure and possibly a certain amount of lifting action, the screws should be located so as to resist the lifting action, and the dowels employed to make the location positive. An example of this kind is presented at *A* in Fig. 4, where a plate *C* is used as a locater for the

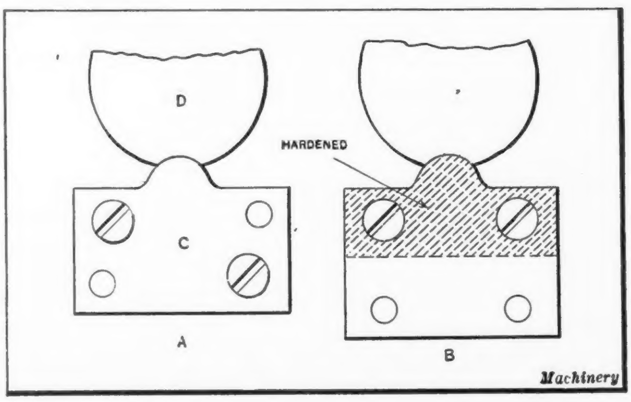


Fig. 4. Case in which the Locating Block can be hardened when the Dowels are positioned as shown at B

work *D*, the latter being held against the plate by means of pressure exerted through a thumb-screw. In this particular instance, it would be much better to place the dowels as shown at *B*, because the latter arrangement permits the block to be hardened at the point where the work makes contact so as to reduce wear.

Drilling the Holes for the Dowels

The method of providing holes for dowels in the part to be attached and the part to which it is fastened will now be briefly dealt with. At *A*, Fig. 5, is illustrated a case in which a block *C* is to be secured in a given position on the wall of a fixture *D*. The block is first located correctly through the use of a micrometer. A C-clamp is then tightened on the parts, as shown, and the dowel-holes drilled.

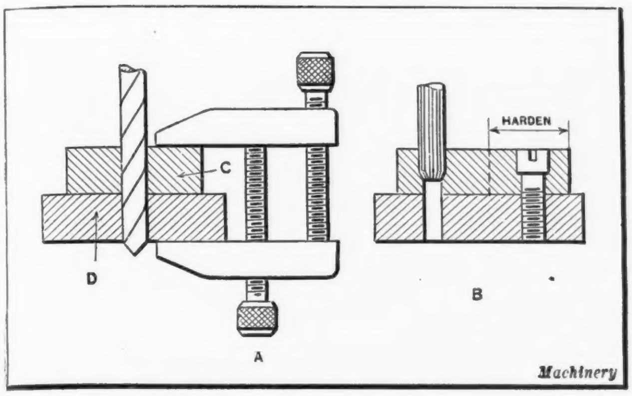


Fig. 5. Method of drilling and reaming a Hole for a Dowel

The drilling operation is succeeded by a reaming operation, as shown at *B*, after which the dowels are driven into position. This arrangement permits drilling after hardening, provided the dowels are located like those shown at *B*, Fig. 4, and the hardening operation affects only that part of the piece in which the screws are placed, the holes for which can be drilled before hardening.

* * *

MILLING CAMS FOR A TEXTILE MACHINE

A Leland-Gifford profile milling machine, changed over to perform a special groove-milling operation in racking cams for knitting machines, is shown in the accompanying illustration. This machine is used by the Leighton Machine Co., Manchester, N. H. The cams are of machine steel and have a groove in them that has four straight offsets or steps, each with a 3/16-inch throw. The cams are made both right- and left-hand, the grooves in opposite-hand cams starting at opposite sides of the faces. The cams are about 2 inches in diameter and have a wide face, and there is a hole ½ inch diameter in them. One of these cams, with its groove rough-milled, may be seen lying on the machine table.

The change in the milling machine consists of supplanting the regular machine table with a slide having a rack attached to the side and an auxiliary table which has a tongue and groove fit on the slide; the auxiliary table is held stationary by two tie-rods *F*, extending to the rear from each side. The table carries the device for supporting and rotating the cams during the milling of the groove. This mechanism consists of three journal boxes, two of which carry a 1⅛-inch hollow spindle on which the master cam *A* is secured by dowel-pins. The hollow spindle has a 2-inch thrust collar, bearing against the journal box *B*, with which the work *C* comes in contact. This construction permits a ½-inch shaft to be used to mount the work on, the shaft having its bearings in the hollow spindle at one end and in the end journal box *D* at the other. The ½-inch shaft is threaded at the end for a nut, by means of which the cam is clamped against the thrust collar.

This spindle mounting is located directly in line with the vertical center of the follow-pin *E* and the milling cutter, and is held in this position by the side tie-rods previously mentioned. The work-carrying spindle is connected by spur gearing to the rack attached to the side of the slide so that by operating handle *G* the slide is moved and the work-spindle rotated.

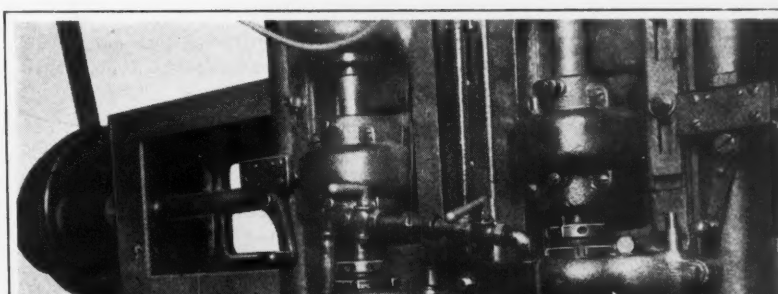
In performing this milling operation, the small shaft is first passed through the work into the hollow spindle and clamped against the thrust collar from the end. The cam is drilled on the end to fit a dowel-pin on the thrust collar, which prevents slipping. The drilling is done in a fixture, the spot for starting the cutter being drilled at the same time. The dowel-pin determines the position of the cam, as well as the starting point in relation to the master cam. In milling, the tool-head is lowered to the correct depth, using a detent stop on the cross-head. One side of the groove is milled first, keeping the follow-pin against the master groove by means of a handle on shaft *H*, until the slide comes to a stop, which indicates the end of the slot. The position of the operator is such that he can operate both handles at the same time, revolving the work and feeding the cross-head along on the cross-rail when the 3/16-inch steps are reached. The head is moved over when the end of the master groove is reached, to mill the opposite side of the groove, and the direction of the slide is reversed. The tool-head is raised to free the work, and the nut on the work-holding shaft released.

The machine has two tool-heads, one for the roughing tool and the other, *J*, for the finishing tool. A two-lip B & S stocking cutter is used for roughing, which leaves 0.005 inch stock on each side of the groove to be removed by finishing with a regular coarse-tooth high-speed B & S end-mill. The total tolerance on the width of this cam slot is 0.0005 inch. When the roughing operation on the cams has been completed, the cross-head is simply moved over to perform the finishing operation.

The master cam has two grooves so that opposite-hand cams can be milled by simply changing its position 180 degrees. To make this change, the slide is moved forward until the gear runs off the end of the rack; then the master cam can be rotated freely by hand. The sides of the master groove and the end of the follow-pin are tapered so that compensation for wear can be made by simply locating the follow-pin deeper in the master groove. The gears are made in two parts to provide for taking up lost motion due to wear; that is, two narrow-face gears constitute the full-width gear, and these may be set with the teeth slightly staggered to permit adjustment as wear occurs.

* * *

In the making of iron and steel, more power is required than in any other single industry. In 1904 this industry used 2,900,000 horsepower; in 1914, over 4,000,000 horsepower; and in 1919, 5,630,000 horsepower. Of this power 18.4 per cent was supplied by electric motors in 1904; 36.7 per cent, in 1914; and about 50 per cent in 1919. This great increase in the use of electric motors is an indication of the increase of electric motor drive, not only in the steel industry, but in all other industries.



Profile Milling Machine changed over for milling Cams

Setting Up Polishing Wheels

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE following recommendations for treating polishing wheels are given in detail because it is the lack of attention to apparently minor points that has been the cause of most of the difficulties met with in obtaining good results in polishing. Every new polishing wheel should be given from one to three coats of sizing, each coat being allowed to dry before the wheel is set up with abrasive and glue. The heads on polishing wheels are either rolled on or put on in paste form, and are known as "rolled heads" and "paste heads," according to the method employed.

Applying Sizing by the Pan Method

Compress polishing wheels having canvas, composition, or felt cushions, and also solid felt wheels, should preferably have the sizing applied by the so-called "pan" method. To prepare the sizing, take the liquid glue already prepared for the heading of the wheels and add three to five parts of hot water to one part of liquid glue, according to the consistency required. The sizing should be placed in a pan in which the wheel can be revolved with the cushion submerged to any depth desired. The temperature of the sizing should be 140 degrees F., and that of the wheel 110 degrees F. The number of sizing coats to be applied depends upon the kind of face required on the wheel. If a hard face is desired, more sizing is necessary than for one that is to be kept very soft and flexible. The sizing should be made a little thicker for each succeeding coat by adding the thicker heading glue, and each coat should be permitted to dry thoroughly before applying another. The second and third coats may be applied by the pan method or by brush. The wheel should then be placed on an arbor, and any uneven spots removed with sandpaper or pumice stone, care being taken not to gouge into the cushion of the wheel. After the sizing coats have been applied, one or more protective coats of heading glue of regular consistency should be brushed on, each coat being allowed to dry; then the wheel should be smoothed down, and the abrasive head put on, after which the wheel should set forty-eight hours.

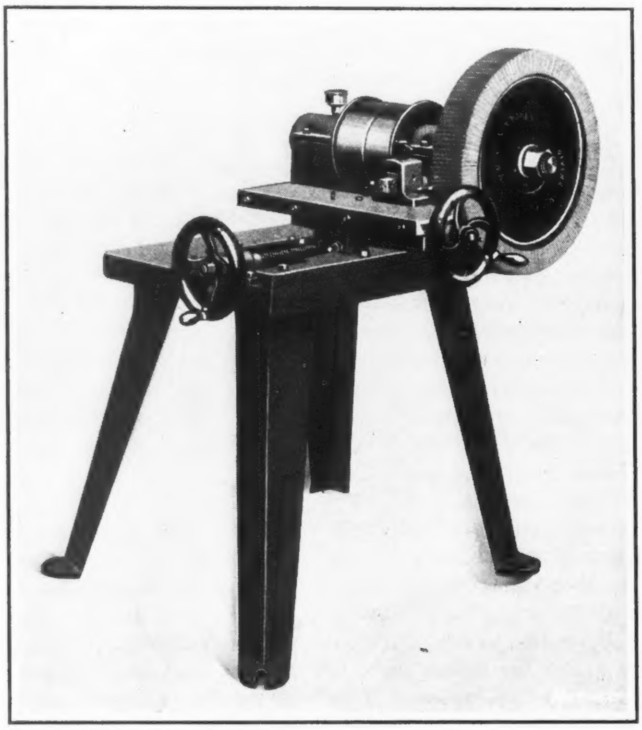


Fig. 1. Wheel-dressing Machine

Applying Sizing by the Brush Method

Compress polishing wheels having leather or paper cushions, and polishing wheels made of glued or cemented canvas or muslin, solid pressed paper, glued or cemented leather disks, solid leather, and leather-strapped wood wheels, may have the sizing applied with a brush. In this case the sizing may be somewhat thicker than when applied by the pan method. Each coat should be permitted to dry, and should be smoothed down before the succeeding coat is brushed on. Afterward the abrasive head is put on. Polishing wheels should be sized every time they are set up, but if the protective coats have not been removed, one or two coats are sufficient.

Applying Rolled Heads

Usually, for roughing and dry-fining, the roll method is used in setting up a wheel. When the wheel is set up by this means, one or two coats are all that is necessary. Two coats are generally applied when the abrasive is coarser than No. 60 grain, and one coat when the grain is finer.

The abrasive should preferably be in a metal trough, long enough to permit the wheel to roll one complete turn in it. The trough should be set on top of a steam coil or some other heating device so that the abrasive can be kept hot. The temperature of the glue should be 150 degrees F., of the abrasive 110 degrees F., and of the wheels 110 degrees F. This will allow the glue to set properly. A cold wheel or abrasive will chill the glue, impair its strength and cause shrinkage cracks. The result will be a head that will not last.

With the wheel mounted on a spindle, apply the glue with a brush as rapidly as possible, in a smooth uniform coat. Then take the wheel with the spindle and roll it in the abrasive, bearing down hard on both ends of the spindle so as to force as much abrasive into the film of glue as possible. The wheel should not be pounded in the abrasive in an effort to obtain even distribution of the grain, as this may throw the wheel out of balance. If the corners of the wheel are to be kept sharp, apply a liberal coat of glue to the sides as well as to the face, and roll it in the emery box cornerwise as well as on the face; for a very sharp corner, dress the head up on a wheel-dressing machine or lathe.

Trim off any superfluous abrasive and glue from the sides of the wheel and lay the wheel carefully on its side or hang it on a peg and allow the glue to set forty-eight hours before using. This is important and should not be overlooked, because glue will not set properly for polishing in less than forty-eight hours. Nor should wheels be dried at any other than normal room temperature. Drying or setting cannot be forced by heating the wheels after the head has been applied. If two or more coats are to be applied, allow each coat to dry before applying the next one.

Applying Paste Heads

Paste heads are used extensively for formed face wheels and for the finer grades of work where the wheels have to run true with the greatest precision possible. The formula for preparing, handling, and using glue varies with different

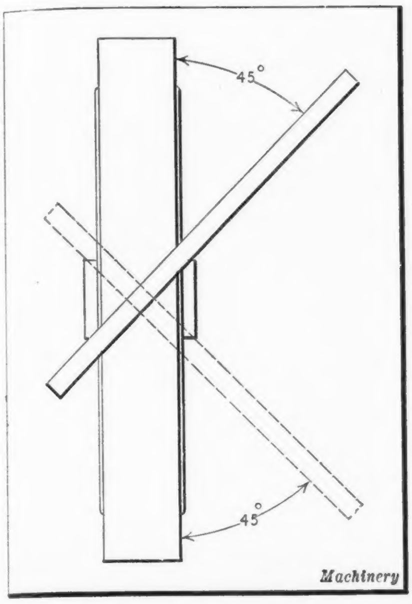


Fig. 2. Method of pounding Polishing Wheel Face to soften the Cushion

kinds of glue. One standard formula provides for adding two pounds of cold distilled water to one pound of dry ground glue. After this has soaked for three hours, bring it to a temperature of 150 degrees F. in the glue heater. When thoroughly melted, add one quart (about two pounds) of hot water, and pour into this slowly about six pounds of the abrasive to make a stiff paste. Stir constantly to prevent the abrasive from settling at the bottom. Allow the paste to cool just enough so that it can be applied to the wheel by the hands. (Other kinds of glue than that referred to in this formula may require more or less hot water and may take up more or less abrasive.)

For convenience have ready an ordinary enameled saucepan, wet the inside surface with warm water so that the paste will not adhere to it and pour into it enough of the paste to head the wheel. Have the wheel ready, either on a wheel-dressing machine, Fig. 1, or on an arbor mounted on two rigid centers so that it will rotate true. Dip the hands into warm water, take a handful of the paste from the saucepan, hold it against the face of the wheel at the top, and then slowly rotate the top of the wheel in a direction away from you, depositing the paste as evenly as possible to a depth of about 3/16 inch. The application should be accomplished in one complete revolution of the wheel. When the wheel is ready for work, the thickness of the head of paste should be from 1/16 to 1/8 inch, the life of the head being proportional to the thickness.

True down the surface by slowly rotating the wheel just one turn by hand against a flat piece of steel, if the face is to be flat. If the face of the wheel is specially formed to fit the contour of a shaped object, use a templet to fit this contour accurately. The steel and templet should be dipped in water before it is used, to prevent the glue from sticking to it, and it should be held against the wheel rigidly in the tool-holder of the wheel-dressing machine or on a rigid tool-rest, if only the arbor and centers are used. Trim the surplus paste from the sides and edges of the wheel, and put the wheel in a drying rack to set forty-eight hours before using.

A typical example of the use of paste heads on forming wheels for coarse work is the removing of flash from the handles of table knives and forks, which is a flexible grinding operation. For such work a grain as coarse as No. 36 is used. As a general rule, however, paste heads are used for the finer grades of work where flour abrasives are used, although this also depends somewhat on the finish required. For glazing table knife blades, paste heads are set up to a thickness of about 3/16 inch. This head is broken up to give a proper flexibility.

To "mellow" a wheel to obtain a soft cushion on a compress canvas or muslin wheel, after the wheel has first been set up with abrasive and glue, pound it thoroughly with a piece of 1½-inch pipe about 2 feet long. The blows should land on the face of the wheel on about a 45-degree diagonal across the face, as shown in Fig. 2. Stand the wheel on the floor or something solid, and after going around the wheel in one direction, reverse the position and go around in the other direction on the other diagonal. This will mellow the cushion to a depth of from ½ inch in the harder density to 1¼ inches in the softer density wheels, according to the force of the blow. This pounding will not damage the wheel. The operation should be repeated each time the wheels are reset until the desired softness is permanently secured, which requires from thirty to sixty days, depending on how much the wheels are in use.

Setting up Oil and Grease Wheels

In setting up wheels for oil or grease work, the cushion of the wheel should be given a coat of sizing on the sides to prevent the oil or grease from adhering to the sides of the wheels and working up underneath the abrasive and glue. Grease getting under the glue is frequently the cause of the abrasive head breaking out in spots.

Cleaning and Reheading Used Wheels

A practice that has long been followed in removing old heads of emery and other abrasives before recoating is to revolve the wheel on rollers running in water and soak off the glue, or remove it by scraping with an abrasive brick or applying mud. This practice is not recommended, and is particularly objectionable in the case of leather-covered wood wheels. Water impairs the usefulness of leather and swells the wood in leather-covered wheels, with the result that a wheel of this kind will warp and run out of true. The leather, when cleaned with an abrasive brick held in the hand, is likely to become uneven and the wheel useless. The general experience is that it is impossible to face a wheel true by using carborundum or other abrasive bricks held in the hand.

Used wheels should be removed and mounted in a lathe or wheel-dressing machine, Fig. 1, a carborundum or other abrasive brick being employed for removing the old emery. The grit of the abrasive in the dressing tool should be about two sizes coarser than that to be removed from the wheel face. For example, in dressing a wheel faced with No. 60 emery, a No. 46 brick should be used. In using any means for removing emery from old wheels, the objective striven for is a face that will run true, and it is not necessary to remove all the old emery if the wheel can be kept square without so doing. After reducing the old wheel to a condition where it can be reheaded in the same manner as when new, the methods already outlined for the setting up of a new wheel may be used in applying the new wheel head.

The fact should be constantly kept in mind that the wheel is merely the agent for carrying the cutting material, which is the abrasive, and if the wheel itself, when new, is put

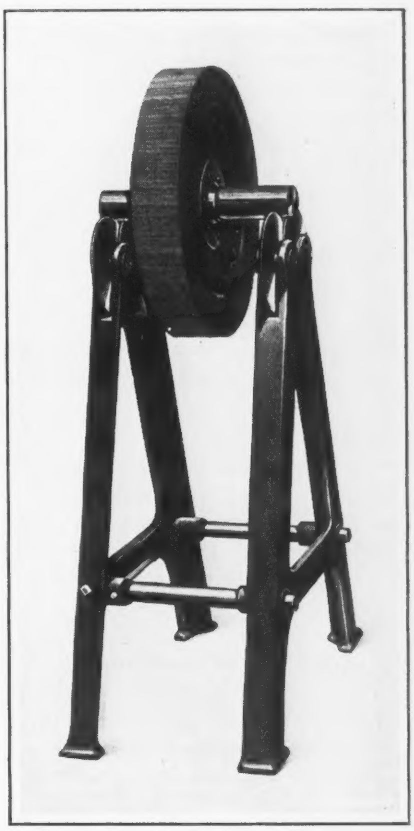


Fig. 3. Machine used for balancing Polishing Wheels

into the condition necessary for the work and kept in that condition by proper care and with the proper outfit of tools for handling it, all that remains to be done to that wheel is to dress off a light coat of the old abrasive and glue, down to the protective heads, and then reset it with a new heading. It is, however, difficult to impress these facts upon some polishers, for they are so used to the idea that all the abrasive must be removed and that the face of the wheel must be cut into to true up the wheel every so often, that they completely lose sight of the fact that it is possible to set the wheel into condition and keep it there practically forever, barring accidents.

If the wheels should become oil-soaked, they can be restored to a condition like new by removing all the glue and emery on the wheel-dressing machine or lathe, and revolving the wheel in a pan of gasoline until thoroughly saturated. Then the grease can be squeezed out by slowly turning the wheel and firmly pressing a flat piece of wood or iron against the face. Several repetitions of this, followed by running the wheel at high speed on a buffing lathe or a wheel-dressing machine to dry it, should remove all the old grease and make the wheel practically new.

Use of Arbor Press and Balancing Equipment

Polishing wheels used on tapered arbors should be carefully removed from the arbor on which they are mounted. They should never be driven off with a hammer or by pounding the end of the arbor on a block, for this batters the hub, ruins the taper, and throws the wheel out of true. With some forms of wheels this is especially likely to spring the wheels out of true. For this work the use of a deep-throat arbor press is recommended so that the wheels may lie flat on the bed of the press, thus preventing injury to the polishing cushion.

After the wheels have been set up and allowed to dry thoroughly, they should be returned to the polishing room and balanced in a good balancing machine. A satisfactory machine for this purpose is the type in which the shaft or arbor of the part to be balanced rests on two pairs of disks mounted in ball bearings (see Fig. 3). The practice of tacking lead weights to the side of a wheel to bring it into balance is not satisfactory. This is dangerous, and many serious accidents have occurred from the lead flying off. The system of putting metal tubes through the wheels near the face for the reception of lead wire is better, safer, and insures greater accuracy. Balancing requires a great deal of time, and must be done by a man who is especially experienced in this work. Accurate balance in polishing wheels is a necessity, because a wheel that is out of balance cannot make smooth contact with the work. It will chatter, and fine work cannot be produced with it.

* * *

COMMON FALLACY IN THE CALCULATION OF EXTENSION SPRINGS

By J. W. ROCKEFELLER, Jr.
Manager, Spring Department, John Chatillon & Sons, New York

In computing the maximum fiber stress in a helical spring due to an imposed load, the following formula, as set forth in a variety of forms in many handbooks, is often used for springs made from round wire or rod.

$$F = \frac{WD}{0.4d^3} \qquad (1)$$

in which F = torsional fiber stress in pounds per square inch;
W = imposed weight, in pounds;
D = mean diameter of coil in inches; and
d = diameter of wire in inches.

The formula given above is an approximation deduced from the following general formula for fiber stress obtaining in torsion,

$$F = \frac{TR}{J} \qquad (2)$$

in which T = imposed torsional moment, in inch-pounds;
R = radius of rod or wire; and
J = polar moment of inertia of a cross-section through the rod or wire.

While the use of these formulas is permissible for the calculation of compression springs, it frequently happens that trouble results when the same basis is used for determining the safe load of extension springs having a hook at one or both ends. The reason that the formulas should not be applied to extension springs having a hook is that, quite apart from the torsional fiber stress obtaining in every coil, there exists at the base of each hook a fiber stress due to combined bending and tension. The magnitude of this stress is more than twice that in the coils. A close approximation of this stress may be made by using the following formula:

$$f = \frac{MR}{I} + \frac{W}{A} \qquad (3)$$

in which f = fiber stress due to bending and tension;
M = bending moment, in inch-pounds, to which the hook is subjected $\left(\frac{WD}{2}\right)$;
R = radius of wire, in inches;
W = weight imposed, in pounds;
I = moment of inertia of a cross-section of the wire about its neutral axis; and
A = area of wire cross-section, in square inches.

As a concrete example of the variation of Formulas two and three, consider the stresses in a spring made of 2-inch diameter wire, having a mean coil diameter of 6 inches, and supporting a load of 10,000 pounds.

The torsional fiber stress in the coils, by Formula (2) is:

$$F = \frac{30{,}000 \times 1}{1.5708} = 19{,}100 \text{ pounds per square inch.}$$

The fiber stress at the base of the hooks, by Formula (3) is:

$$f = \frac{30{,}000 \times 1}{0.7854} + \frac{10{,}000}{3.1416} = 41{,}380 \text{ pounds per square inch}$$

* * *

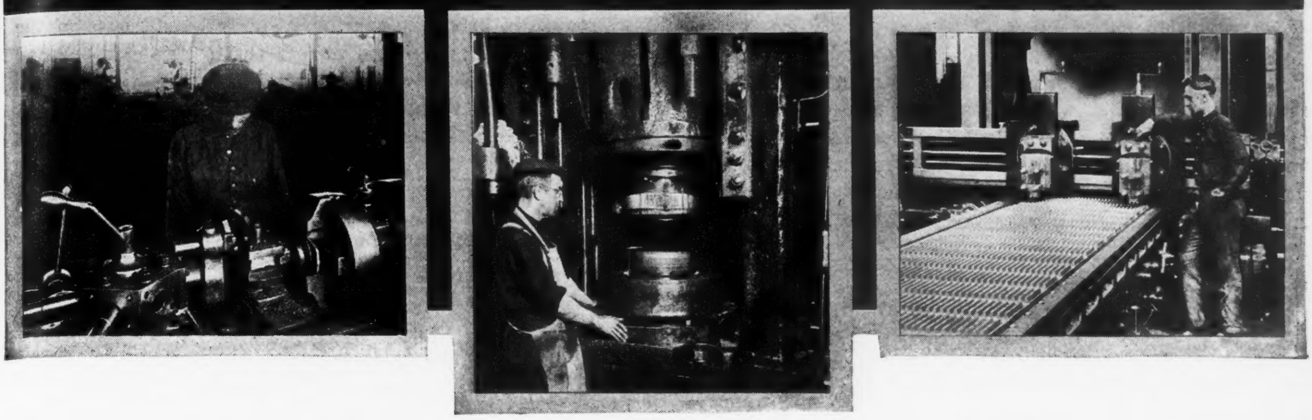
INVESTIGATION OF GAGE STEELS

The Gage Steel Committee of the Bureau of Standards is investigating three important problems in regard to the improvement of steel for gages, namely, resistance to wear, dimensional changes due to hardening, and time changes. As yet the investigation of the wearing qualities of gage steels has been confined to a study of the apparatus used for this work, and to the improvement of this apparatus so that all factors can be controlled in order to insure uniform standardized test conditions.

In testing for dimensional changes due to hardening, it was found that surface oxidation may easily result in a scale forming which causes a greater change in size than is expected. If the scale is removed, some metal is lost and the change recorded is less than that due to hardening. Thus the changes due to hardening may be completely hidden by the scaling effect. However, by allowing illuminating gas to flow into the furnace at a rate just sufficient to burn the air leaking in, oxidation is prevented.

The specimens on test are now being held and measured occasionally for dimensional changes due to time. Treatments are also planned to bring out the significant facts in relation to ageing. Sufficient time has not yet elapsed to permit any conclusions to be drawn. The complete report (known as Third Progress Report) may be obtained from the Gage Steel Committee, Bureau of Standards, Washington.

Letters on Practical Subjects

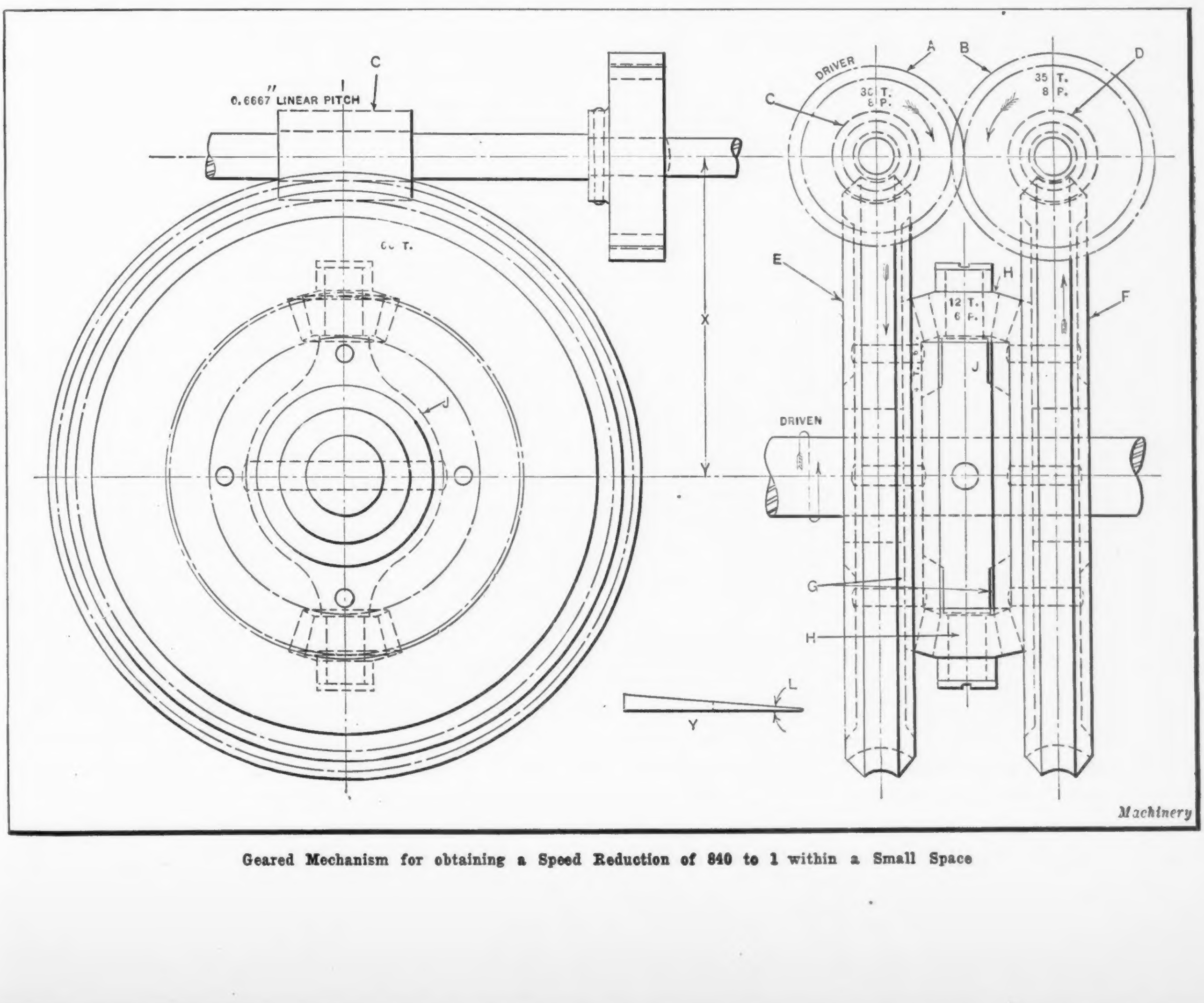


DIFFERENTIAL MECHANISM FOR LARGE SPEED REDUCTION

In machine design large reductions in speed are often obtained by the use of a differential mechanism, especially when the reducing unit must occupy a comparatively small amount of space. A differential mechanism in which a reduction of 840 to 1 is secured by using only two spur gears, two worms, two worm-wheels, two bevel gears, two bevel pinions and a yoke, is shown in the accompanying illustration. The reduction ratio of this gearing may be altered to suit conditions by simply varying the number of teeth in the two spur gears. Dimension X is approximately 7⅛ inches on this particular lay-out.

Spur gear A is the driving member of the differential unit. It is mounted on the same shaft as worm C, and through these two parts drives worm-wheel E. Gear A also meshes with gear B, and thus drives a shaft running parallel to that on which it is mounted. On the second shaft is a worm D by means of which power is transmitted to worm-wheel F. Gears A and B revolve in opposite directions, and as the thread of both worms is right-hand, worm-wheels E and F also rotate in opposite directions. Pinned to the adjacent sides of the two worm-wheels are bevel gears G, which, together with their respective worm-wheels, are free to turn on the driven shaft. These bevel gears mesh with two idler pinions on studs at opposite ends of driving yoke J, which is pinned to the driven shaft. The idler pinions are held on the studs by means of screws.

The large reduction obtained by this unit is due to giving spur gear B five more teeth than gear A. As a consequence, gear B makes only 30/35 revolution per revolution of gear A. The ratio of each set of worm-gearing is 60 to 1, and so for each revolution of gear A, worm-wheel E makes 1/60 revolution. The 30/35 revolution imparted to gear B at the same time causes worm-wheel F to turn 1/70 revolution



Geared Mechanism for obtaining a Speed Reduction of 840 to 1 within a Small Space

in the opposite direction to that in which worm-wheel *E* is revolved. Because of the two worm-wheels revolving in opposite directions, the result on yoke *J* is the same as if worm-wheel *F* were held stationary and worm-wheel *E* were moved the difference between 1/60 and 1/70 revolution. This would mean a forward movement of worm-wheel *E* of 1/420 revolution.

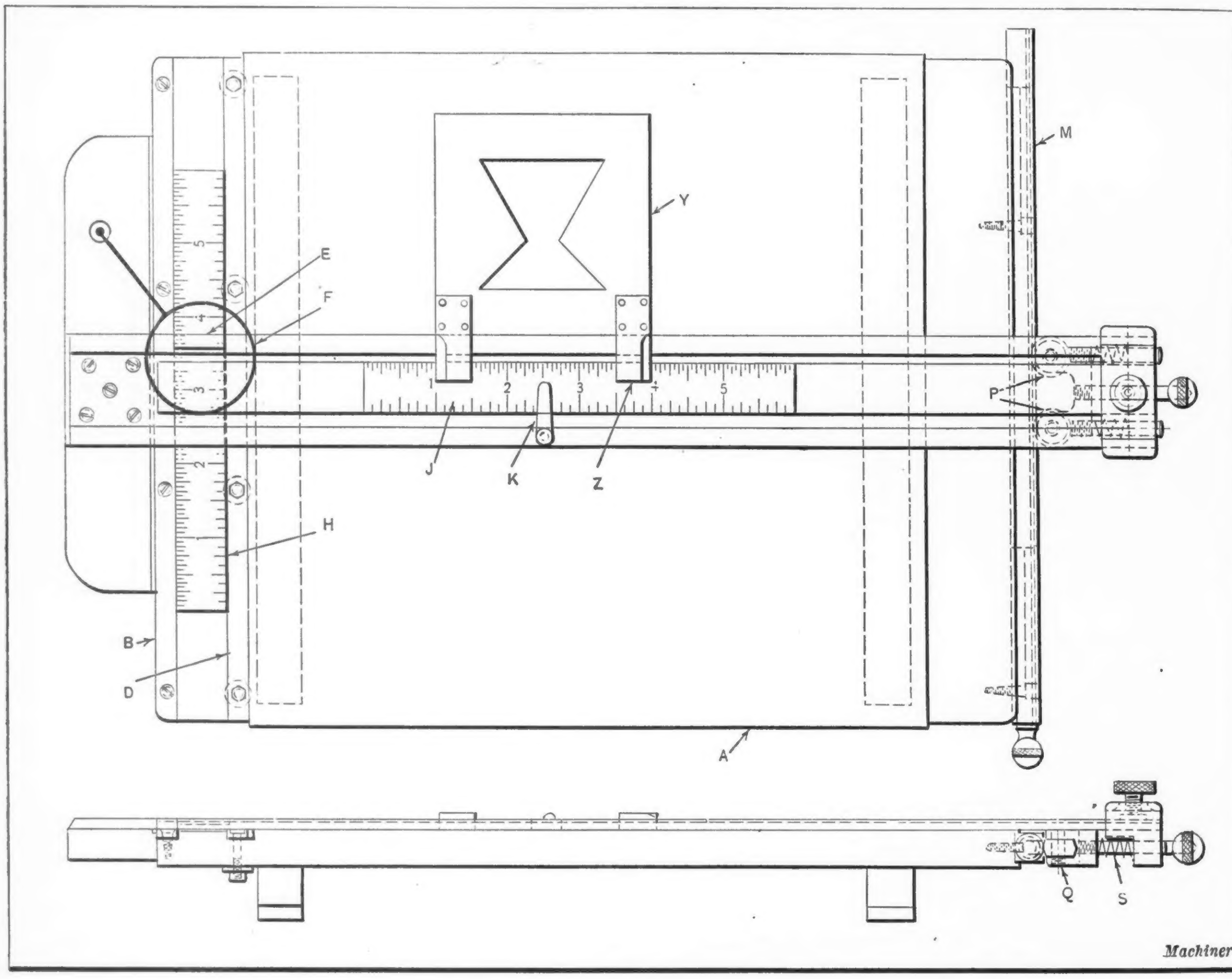
As the center of driving yoke *J* is located half way between bevel gears *G*, the actual movement of the yoke per revolution of gear *A* will be only one-half the difference between the forward and backward movements of the two worm-wheels, or 1/840 revolution. This can be easily proved by constructing a triangle as shown at *Y*, in which the line adjacent to angle *L* represents the pitch diameter of pinions *H*, and the length of the opposite side equals the distance that a point on the pitch circle of the bevel gear on worm-wheel *E* would move during 1/420 revolution. Then if the adjacent side is bisected and a perpendicular is erected at that point, the length of the perpendicular will be one-half the length of the opposite side of the triangle; this perpendicular line will equal the distance a point on the center line of the yoke, located from the center of the driven shaft a distance equal to the pitch radius of bevel gears *G*, will move during the movement of the bevel gear on worm-wheel *E*. This yoke movement equals 1/840 revolution.

Fitchburg, Mass. E. E. LAKSO

DRAFTING DEVICE

A drafting device that can be made in sizes especially suited to the needs of the field engineer or in larger sizes adapted for general use in the drafting-room is shown in the accompanying illustration. The T-square can be moved up and down freely and can be readily detached from the drawing-board. The construction of the device is such that the T-square is held in contact with the side of the board, thus insuring accuracy in the parallelism of all lines drawn along the guiding edge of the T-square blade.

While the general construction of the device is shown quite clearly in the illustration, there are a few points that may require a brief explanation. The left-hand edge of the drawing-board *A* is recessed to receive the guide strip *B* and the adjacent strip *D*, which is slightly tapered. Both strips *B* and *D* are made from sheet brass or aluminum 0.125 inch thick, and are set into recesses so that they are flush with the top of the board. The steel scale slides between pieces *B* and *D*. The tapered strip *D* is adjusted so that the scale can be moved up or down by the fingers without any perceptible side motion. Scales *H* and *J* for a small or medium size outfit may be the regular Brown & Sharpe 6-inch size, 11/16 inch wide, and 0.050 inch thick. Longer scales should be employed for outfits of larger sizes. The position of the scales can be changed in the grooves, so that ⅛- and 1/16-inch or 1/32- and 1/64-inch graduations will be in the working position. Metric scales can also be used when necessary.



A Drafting Device of Compact and Convenient Design

A recess 11/16 inch wide and 0.050 inch deep is cut in the T-square blade to receive scale *J*. This scale must slide freely without any side play and it must be flush with the top of the T-square blade. A spring *K* adjusted to the proper tension holds this scale in place to prevent it from being accidentally moved in the groove.

A slot 1/16-inch deep at the right-hand end of the drawing-board receives the T-square retainer guide *M*. This guide is made from square, cold-rolled steel or brass rod, and has a vee planed in one side to form a track for the two rolls *P*. The guide *M* is slotted in two places to allow it to be extended two inches below the lower edge of the board when lines are to be drawn close to this edge. The

rolls P of the T-square retainer are held in position by screws Q, and the required tension is obtained by means of the two helical springs S.

The triangle Y is of unusual design, being made square, so that all of the four sides can be used, and cut out in the center to provide pencil guiding edges located at angles of 45, 30, and 60 degrees with the edge of the T-square blade. This triangle can be made from vulcanite or any suitable composition, and should be about 0.1 inch thicker than the blade of the T-square so that the two indicators Z, which are made from the same material, will slide over the top of the blade. These indicators are fastened to the triangle by means of four small screws or rivets. The working edges of these indicators, as well as the edge of the T-square at E, are beveled to facilitate the setting of the T-square and triangle by means of the graduated scales. A small magnifying glass F may be fastened to the head of the T-square as shown, so that it can be swung into position over the beveled parts E when accurate location of the T-square blade is necessary.

Bridgeport, Conn. B. R. Wicks

MAKING AND USING A PRICK-PUNCH INDICATOR

Great care is required in laying out drill jigs, templets, etc., when the accurate spacing of holes is necessary. While the button system of locating holes is used by nearly all toolmakers when very accurate results are required, the method is a slow and tiresome one. Accurately spaced prick-punch marks can often be used to locate holes. This method is quicker than the button method, and for certain classes of work will give sufficiently accurate results. Dividers are sometimes used to check the accuracy of prick-punch lay-outs, but this permits a chance for inaccuracies to develop, particularly when springy dividers are used.

The prick-punch indicator described in this article will enable anyone to lay out accurately and check for accuracy any common prick-punch lay-out. The design of the indicator is such that it can be used with the ordinary type of metal beam dividers. A special head B of the same general dimensions as the end head of the beam dividers is made up as shown in Fig. 2. The screw portion of the head is made considerably longer than on the regular divider point, and on the top of this extended screw is located the graduated head A of the instrument. An indicator needle

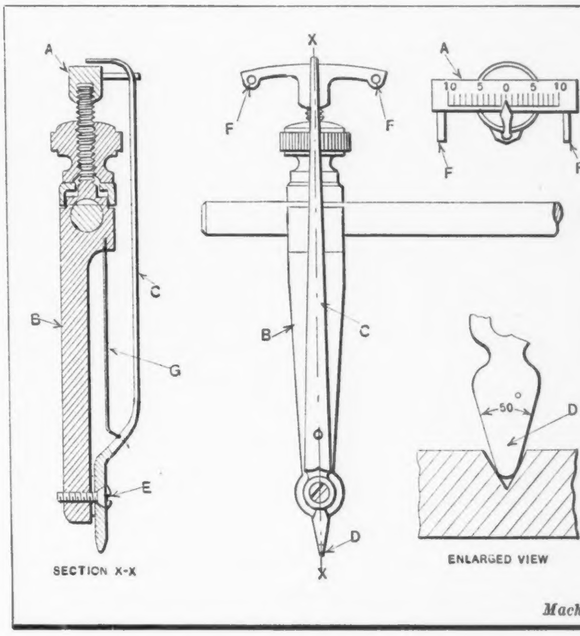


Fig. 2. Prick-punch Indicator

C made of thin steel spring stock and terminating in a rounded point D, as shown in the enlarged sectional view in the lower right-hand corner of the illustration, is attached to head B by the small screw E. Screw E serves as a pivot for needle C. The foot or end of the needle should be made to the exact shape shown in the enlarged view. If a pointed end were used instead of a rounded one, inaccuracies would occur.

The graduated head A has two small pins F in the ends of the head segments, which limit the travel of the needle point. The head is graduated in ten divisions on each side of the zero line, the length of the needle and the position of the pivot screw E being such that each graduation represents a movement of 0.001 inch at the point where the foot D is in contact with the prick-punch mark. A piece of music wire G is fastened to part B for the purpose of centralizing needle C so that its indicating point will normally rest on the zero mark.

The importance of carefully forming the foot D to the shape indicated cannot be over-emphasized. As most toolmakers and machinists grind their prick-punches to an included angle of 60 degrees or more, the angle of the foot must be somewhat less. An angle of 50 degrees is about right for use in prick marks made with a punch ground to the usual 60-degree angle. The rounded or spherical end of foot D allows this member to bear on all sides of the prick-punch mark and not on the bottom.

In Fig. 3, the indicator is shown in position for checking the distance between prick-punch marks H and J. The indicator can also be used to check the spacing of the six prick-punch marks shown. For instance the distance between prick marks H and K can be checked, the same as the distance between prick marks H and J.

Two methods can be used in setting the fixed and the indicating points to check a given dimension. One is to make a special setting tool from a 12-inch length of square key stock. This piece of stock is fitted with a fixed and a sliding head, as shown in the upper view of Fig. 1. Both the fixed and the sliding head have accurate centers M in which the fixed and indicating points of the indicator are placed in making a setting. The centers M in the blocks are so located that

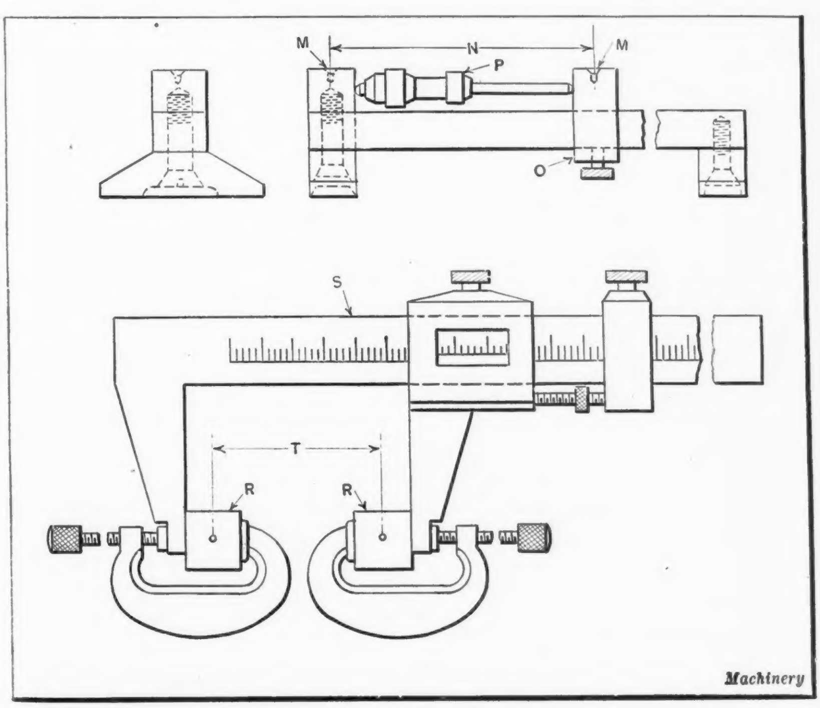


Fig. 1. Methods of setting the Indicator to a Given Dimension

½ inch must be added to the reading of the inside micrometer P to obtain the exact dimension N. An ordinary steel scale can, of course, be used in place of the inside micrometer when a high degree of accuracy is not required.

Another method of setting the indicator is to use two ½-inch square tool-steel blocks such as shown at R in the lower view of Fig. 1 in conjunction with a vernier caliper S. The sum of ½ inch must, of course, be added to the vernier reading to obtain the actual distance T between the two prick-punch marks in the blocks clamped to the measuring ends of the micrometer. The prick-punched lay-out which has been checked with an indicator as described, is accurately located on the faceplate of the lathe for drilling and boring by employing the ordinary type of center indicator. When the needle of the center indicator shows no movement, the workman can be assured that the piece is

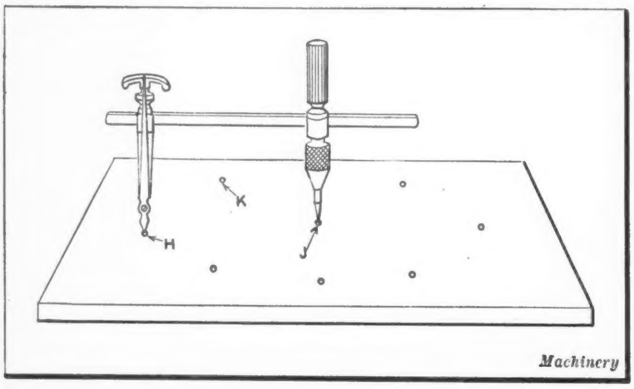


Fig. 3. Method of checking Spacing between Prick-punch Marks

accurately centered for drilling. This type of indicator eliminates the necessity for drilling and tapping small holes previous to the regular drilling operation, as is necessary when the button method is employed.

Allentown, Pa. JOE V. ROMIG

THE USE OF PHOTOSTAT PRINTS

A mistaken idea regarding the cost of photostat prints seems to be prevalent in many drafting-rooms and engineering departments. The opinion seems to be quite general that the photostat method of copying such matter as cannot be readily blueprinted is in use only by the Government and large corporations. There is no doubt that the photostat process is invaluable for making copies from pages of catalogues and untraced drawings. In the writer's opinion, however, the greatest value of this process in industrial work is in making standard size reproductions of large or assorted sizes of drawings. Photostat prints, thus made to some standard size, can be readily bound or conveniently carried in loose-leaf form.

During the war a certain firm regularly made more than 100 photostat prints daily. These prints were all 18 by 12 inches in size, and the average cost was from ten to fifteen cents each. At the time these prints were made the chemicals used in the photostat process were high in price, but the cost is somewhat lower now, and even though the cost of photostat prints is still somewhat higher than that of blueprints, the advantages of the former process as stated in the preceding will in many cases more than offset the difference in cost. S. N. BACON

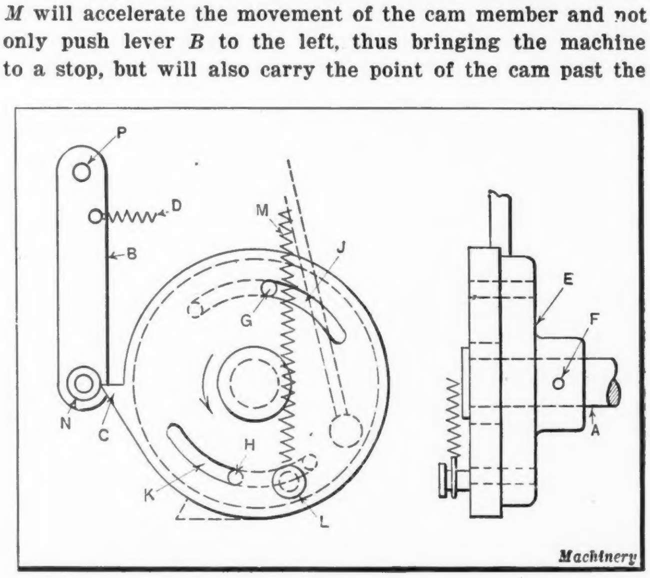
STARTING AND STOPPING DEVICE

It is an easy matter to provide a means of stopping a machine with its own power by the use of a cam or some similar mechanical device, but it is a more difficult problem to design a device that will automatically stop a machine and start it again so that it is only momentarily brought to a full stop. With the usual type of device designed simply to shut off the power, there is no stored up energy that can be utilized to start the machine again without attention on the part of the operator. In the accompanying illustration is shown a simple and efficient device for shutting off the power momentarily in a purely automatic manner.

The shaft A is a part of the machine that rotates while the machine is in operation. When it is desired to stop the motive power, latch B is moved to the left, pivoting about pin P. The machine is started again by moving latch B back to the right-hand position. The problem is to provide a means of throwing latch B to the left or stopping position and then back again to the running position without attention on the part of the operator. The latch can be readily moved to the left by means of a cam, such as shown at C, but the instant that the cam has so acted the machine will stop, and the cam will be left in such a position that the lever cannot be moved back to the starting position, either through the action of a spring, such as shown at D, or by other means.

To overcome this difficulty, shaft A was provided with a flange member E secured by the pin F. The cam member C is free to turn on shaft A, but its movement relative to flange E is limited by two pins G and H, which are driven into flange E and allowed to project through the slots J and K in the cam member. On the cam member is a stud L to which is secured one end of a spring M, the other end being secured to some part of the machine.

When shaft A travels in the direction indicated by the arrow, the flange E will drive the cam member C in the same direction. As the pin L reaches its highest point and begins its descent, it will act against the pressure exerted by spring M until the instant that pin L passes a vertical line through the center of the shaft. At this point spring M will accelerate the movement of the cam member and not only push lever B to the left, thus bringing the machine to a stop, but will also carry the point of the cam past the



Automatic Starting and Stopping Device

roller N, so that lever B will be returned to its original position by the action of spring D. The machine will thus be started automatically after having been stopped for an instant.

Poughkeepsie, N. Y. J. J. THOMPSON

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The production of alloy steel increased almost tenfold between 1909 and 1920. In 1909 the total production of alloy steel was 181,000 gross tons, while in 1920 it was 1,660,000 gross tons. The production fell off in 1921 due to the industrial depression, but it is of interest to note that it did not fall off quite as much, proportionately, as the total tonnage of all classes of steel. From 1918 to 1921, inclusive, the production of alloy steels averaged about 4 per cent of the total steel production of the country. In 1909, it was only 0.75 per cent.

Questions and Answers

WAVY LINES IN DIES

J. H. B.—What would be the simplest way of cutting wavy lines in dies for postage stamp cancellation machines to produce a wavy canceling line on the stamp and envelope?

PROPER SUBJECT MATTER FOR A TRADEMARK

S. E. E. Co.—Will you please tell me what constitutes a proper subject matter for a U. S. trademark?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

A trademark is an arbitrary sign, word, or symbol used to distinguish one manufacturer's product from that of another, and to impress a particular article on the mind of the public. A trademark must not in any way be descriptive of the product nor should it be in the least deceptive. For instance, if a trademark for a soap were claimed on the word "Magnetic," the claim would be rejected on two grounds. First, because soap could not be magnetic, and so the word would be deceptive and misleading, and second, because the term would be descriptive if correctly employed. A proper name, geographical term, or the name of cities, etc., also cannot be used as trademarks.

The first letters in the words of a company's name are frequently used with the abbreviation of company. In your case the coined word "Seeco" would result, and as this word is arbitrary and meaningless, it would be proper subject matter for a trademark, provided it had not been used by another prior to your adoption and use of it.

HORSEPOWER TRANSMITTED BY WORM GEARING

S. D. J.—What general rule or formula is used for determining the horsepower transmitted by worm-gearing and to what extent, if any, is the power-transmitting capacity affected by the number of threads on the worm?

In determining the allowable load for worm-gearing, the danger of overheating and of abrasion are usually of greater importance than the strength, because if the gearing is so proportioned as to prevent abrasion and overheating, the strength will ordinarily be greater than is required merely to withstand the stresses due to the load. Overheating is the cause of most worm-gear failures. It indicates that the frictional loss is so great that the heat is generated faster than it can be dissipated; consequently the action of the lubricant becomes less effective as the temperature rises, which, in turn, causes a further increase in frictional resistance. Finally, the oil film between the surfaces and contact is no longer maintained and abrasion begins. It is evident that there is less danger of overheating and abrasion with lower velocities and intermittent service, and also when a lubricant of good quality is used.

In designing worm drives, the worm diameter should be as small as possible to reduce the velocity. If the worm diameter is unnecessarily large, the gearing may become hot and start to cut. Another important point is to use a multiple-threaded worm in preference to a single-threaded worm whenever conditions permit, to increase efficiency.

For determining the power that worm-gearing will transmit without danger of excessive heating or abrasion, the Foote Bros. Gear & Machine Co. recommends the use of the Lewis formula for spur gears, the calculations being based on the velocity of the worm-gear. For instance, when using the formula for spur gears given on page 202 of November MACHINERY, as Formula (2), in the article "Mechanical Transmission of Power," insert the velocity of the worm-gear in feet per minute, its diametral pitch, and face width. This width, as measured along the pitch circle may be determined as follows: Multiply the pitch radius of the worm by a value L (see the table on page 62 of MACHINERY'S HANDBOOK) corresponding to the face angle of the worm-wheel.

It will be noted that the application of the Lewis spur gear formula to worm-gearing does not allow for the kind of worm used, that is, whether it is single- or multiple-threaded. There is, however, an increase in the efficiency of worm-gearing as the helix angle of the worm-thread is increased, although this does not amount to much for angles larger than 25 or 30 degrees. If the coefficient of friction is, say, 0.040 and the helix angle of the worm is 10 degrees, the efficiency will be about 0.81 per cent, whereas if the helix angle is increased to 20 degrees, the efficiency will be about 0.89 per cent. The frictional loss per single revolution of a single-threaded worm will be about the same as for a double-threaded worm, but since the latter rotates the worm-wheel at twice the velocity, double the power may be transmitted for approximately the same frictional loss, thus increasing the efficiency.

In actual practice, the gain through the use of multiple-threaded worms, as compared with single threads, varies according to the helix angles, as previously intimated, and differences in efficiency are also much less for the lower coefficients of friction. The latter, in turn, vary according to the quality of lubrication, and the mechanical excellence of the gearing or the grade of workmanship. These factors are subject to considerable variation, but since their effect on the amount of power transmitted (under average conditions regarding helix angles and lubrication), would not be excessive, the helix angle of the thread and the theoretical efficiency of the gearing are disregarded, in order to make use of the comparatively simple Lewis formula. Moreover, this formula as applied to worm-gearing provides a margin of safety which covers all reasonable variations in practice. Thus, the power-transmitting capacity obtained by this formula applies to single-threaded worms having at least adequate grease lubrication. Consequently, any increase of efficiency due to the use of a multiple-threaded worm and possible oil bath lubrication simply provides an overload capacity or a greater factor of safety than allowed for by the formula.

Frequently the safe working load on the teeth is desired rather than the horsepower that may be transmitted. The working load may be determined by multiplying the number of horsepower (as obtained by the Lewis formula) by 33,000 and dividing the product by the velocity of the worm-wheel in feet per minute.

The efficiency of worm-gearing (neglecting bearing losses) may be obtained accurately enough for practical purposes by dividing the lead by the lead plus the product of the coefficient of friction and the pitch circumference of the worm. The efficiency may also be obtained by dividing the tangent of the helix angle (measured perpendicular to the axis of the worm) by the tangent of the helix angle plus the coefficient of friction.

When the coefficient of friction equals the tangent of the helix angle, the gearing is self-locking and the worm cannot be rotated by the wheel. Owing to friction in the bearings, the gearing might be non-reversible or self-locking for larger helix angles than indicated by this rule.

Economics of the Machine Tool Industry*

By ERNEST F. DuBRUL, General Manager, National Machine Tool Builders' Association

FOR many centuries even the most progressive nations had to apply most of their muscle power to producing food, shelter, and clothing, and so did not have much time to produce comforts or luxuries. About 1760 began the series of great industrial inventions that changed hand industry into machine industry. While these inventions increased the supply of manufactured goods, food production continued to require mainly muscle power for another eighty years, until McCormick's inventions supplanted, by mechanical appliances, the muscle power and skill of many agricultural laborers. One man thereafter could raise food for many besides himself and his family, surplus labor was released from farming, and manufacturing began to grow rapidly. Increasing efficiency of farm machinery will continue to release more men from the necessity of raising food, and allow them to earn better livings working in factories than they could earn on less productive farms.

An impression of the rapid growth in productivity may be obtained from a comparison of the estimated value of manufactures, which in 1812 was $170,000,000 for the United States, whereas in 1919 it was over $62,000,000,000. Of this total, nearly one billion represented industrial or shop machinery alone, not counting electrical equipment, automotive or other vehicles, tractors, agricultural machinery, railway cars, and locomotives. Of the industrial machinery, machine tools form the largest class, which is about twice as large in value as the next largest class—textile machinery.

Basic Position of Machine Tool Industry

Because the blacksmith made the tools for all the other workers who built the temple of Solomon, the legend is that King Solomon honored the blacksmith above all the other workers. The modern machine tool builder now stands in that blacksmith's place, producing the master tools for all other crafts.

In the following an outline picture will be given of the machine tool industry, by an analysis of the statistics of the census of manufacture of 1919. First, let us see how the shops that make the master tools compare in relative size with all the factories that make all the goods the country produces. The census gives the number of establishments, capital employed, value of the product, costs of material, fuel, power, wages, salaries, contract work, rents, taxes, number of wage-earners, and number of salaried employes.

Analysis of Census Figures

By analyzing the figures of the census we find that the average machine tool shop is about four times as large as the average factory of all industries as judged by the items of capital, number of wage-earners, added value, wages and salaries. As to material used, however, the figures are more moderate, because the machine tool builder takes relatively crude material, and with skilled labor and inventive brains transforms it into a product of high utility and value.

The size of his shop shows the machine tool man to be a good manager, and other things confirm this. He paid his men better than the average factory employe was paid elsewhere, but his salary roll was considerably less in proportion, and the number of supervising personnel is also proportionately smaller. While salaries formed 27.3 per cent of the payroll of the average shop, they are only 21 per cent of the payroll of the machine tool shop.

*Abstract of a paper read before the Philadelphia Section of the American Society of Mechanical Engineers, February 27, 1923.

The item of value added by manufacturing processes is the index of manufacturing activity. This item excludes the value of the material from the total value. The manufacturer's function is to convert material into finished product. Of this added value, the machine tool salary roll was only 11 per cent while the average for all factories was 16 per cent, so evidently he was not extravagant in that particular. As to federal taxes, the machine tool builder paid more than his share, whether figured on "per shop" basis or on "per wage-earner" basis, or as a percentage of what was left after deducting the cost of material and wages.

After taking out of the total value all the amounts specified, there still remains a balance. This is designated as "residue," for want of a better term. As the census figures do not go into further detail, we can only say that this residue includes costs like depreciation, obsolescence, insurance, advertising, repairs, interest, legal and patent costs, auditing, traveling, and all other expenses not covered by the specific expenses mentioned. It would be proper to deduct from this an allowance for interest on capital invested, which in 1919, at the going rate, was easily 7 per cent. This would allow the average shop $19,720, and the machine tool shop $82,361, although the machine tool builder used $600 less capital per wage-earner than the average shop.

Value Added by Manufacturing Processes

The average manufacturer took $4100 worth of material and fuel per wage-earner in 1919, and by processing, added to it $2752 worth of utility, or 66 per cent. But the creative machine tool builder took $1100 worth of material per wage-earner, and added $2887 or 262 per cent of utility to it. As the real function of all manufacturing is to add utility, it would seem fair to compare them by using, as a base, the value added. To produce $100 of added value at the market price of his goods, the average manufacturer employed $177 of capital against the machine tool builder's $150. The average manufacturer used $149 worth of material against the machine tool builder's $38. It cost them both about the same for the expenses specified, except that federal taxes took $3 more out of the machine tool builder. If now we allot 7 per cent interest on the capital invested in each case, the average manufacturer had a net residue somewhat greater than the machine tool builder.

Influence of Size of Shop

If the machine tool shops are classified according to the annual value of their product, some interesting conclusions may be drawn. The small residue per wage-earner left in shops below the $100,000 line is hardly enough to pay interest, to say nothing of allowing for other expenses and profit. The men who have these small shops seem to be taking a chance that they can ill afford. Yet 44 per cent of the machine tool builders were doing that very thing. In the same classes, under "All Industries" there was a bigger percentage of small shops, but they apparently had a bigger residue per wage-earner, indicating a better chance to succeed on a small scale in shops other than machine tool shops. It is also worth noting that in each class, the residue per wage-earner is less in machine tool shops than the average for manufacturing plants.

The accompanying table throws some interesting light on the concentration of industry in large establishments.

While there are many small shops, the greatest bulk of production is in shops turning out $1,000,000 worth of product or more. While the shops turning out less than $100,000 per year in all industries are nearly 80 per cent of the general total, they employ only 12 per cent of the wage-earners, and produce less than 10 per cent of the added value. The smaller machine tool shops, almost 44 per cent of the number, produce only 3 per cent of the added value with 4 per cent of the wage-earners. About 70 per cent of the added value is produced in about 13 per cent of the machine tool shops that averaged $2,000,000 of added value, and $3,000,000 of capital. Every one of these concerns was started on a small scale, but today the machine tool business has reached such magnitude that a small business is greatly handicapped. If a man has only a little capital, he had better hunt somewhere else for a place to exercise his talents, rather than start a new machine tool shop.

Problems of Management of Machine Tool Shops

The fluctuating nature of the demand for machine tools creates serious problems. It is evident that the more regular an industry's demand, the lower can be its costs and the easier its managerial problems. The peculiarities of human nature, as manifested in business cycles, compel the builder of machine tools to face relatively short and sharp peaks of activity, followed by relatively long and deep depressions. The industry, therefore, has a naturally bad load factor, for some very human reasons. The first is that most people do not look very far ahead, and most machine tool users are not different in that particular. Therefore, comparatively few users forecast their machine tool requirements to any great extent. In a period of depression, the user's shop is more or less idle, and he has more than enough machinery to supply the restricted demand for his own goods. He is mentally so depressed by dull business that he cannot bring himself to even think of a time just a few months ahead when his business will be more active, and when the natural growth of business will demand more of his goods than he was able to make in his last boom. Not forecasting what the future has in store, and how long the depression in his own business will last, he simply will not spend money on plant improvements when he could be making them to the best advantage.

Only as his orders become decidedly plentiful, does the user of machine tools think of replacing old equipment or adding new equipment. The necessity for more production rather than the desire to lower costs seems to lead most men to buy new machines. Because the newer types are of greater productive capacity than the old ones, cost reduction follows, but this seems to be merely an incidental benefit in the buyer's mind. Only when his own orders press him does he order new equipment, hesitatingly at first, then with greater confidence, then with insistence, and at the height of a boom, perhaps with reckless abandonment of caution. When he realizes that the end of his own boom is in sight, he not only stops ordering machinery, but may even try to cancel orders that were previously given.

A Business of Booms and Depressions

Consider now the difficulties of the machine tool builder in trying to regulate his operations. At the height of his own previous boom, he had as full a force of men as he could get, working night and day. He had also placed a lot of contracts for castings and other material, far in advance, in large quantity, at high prices, to be able to supply his customers' wants without delay. Even though he had been quoting six to eighteen months delivery, his orders had been piling in on him with increasing speed. When his orders began to fall off, he had this large inventory thrown on his shoulders. Then he received many cancellations from people who should have been compelled to live up to their contracts. If he was unwise enough to accept them, he found himself with large inventories in all stages of completion, but without sales.

Being of the adventurous rather than of the prudent type, and of the inventive rather than of the commercial turn of mind, he had not given much consideration to the progress of the business cycle. As the economics of the cycle had not been pointed out to him, he did not realize that his industry would be among the first to slump in a cycle, and that the slump in machine tool orders is merely one of the signs of coming trouble elsewhere. He took counsel of hope rather than of prudence. It had cost him so much in money and effort to get his working force together that he hated to break it up. If his product was not of a type built to order, he kept on working and built stock instead of shutting down his plant. Then, too, he had a goodly share of that human sympathy that leads an employer to keep his men employed as long as possible rather than to throw them out of work. Looking back now, he realizes that it would have been better both for his men and for himself, to have shut down as his orders were filled, and to have waited to build his stock during the depression rather than at the crest of a boom.

When his own financial strength was threatened, even the most adventurous and sympathetic could no longer keep on producing, at high costs, machines for which there was no sale at any price. So the industry finally had to do late what it should have done early in the slump, that is, shut down and wait for improvement in conditions in other lines to revive the demand for machine tools.

The Effect of a Business Depression on Machine Tools

Pressure of creditors compels the financially weak to sacrifice goods to get money with which to pay their debts. A

COMPARISON BETWEEN FACTORIES OF DIFFERENT SIZES IN MACHINE TOOL AND ALL INDUSTRIES

Basis of Comparison	All Industries						Machine Tool Industry					
	Size of Plant, by Value of Product					Total, Per Cent	Size of Plant, by Value of Product					Total, Per Cent
	$20,000 or Less	$20,000 to $100,000	$100,000 to $500,000	$500,000 to $1,000,000	Over $1,000,000		$20,000 or Less	$20,000 to $100,000	$100,000 to $500,000	$500,000 to $1,000,000	Over $1,000,000	
No. of establishments, per cent	52.7	26.8	13.7	3.2	3.6	100	16.4	27.3	33.2	10.2	12.9	100
No. of wage-earners, per cent	3.2	8.7	18.9	12.3	56.9	100	0.5	3.7	15.3	13.6	66.9	100
Capital employed, per cent	1.8	5.7	14.4	10.4	67.7	100	0.3	2.8	15.0	13.1	68.8	100
Value of product, per cent	1.8	5.7	14.4	10.4	67.7	100	0.3	2.8	15.0	13.1	68.8	100
Material and power, per cent	1.2	4.9	13.0	9.6	71.3	100	0.4	3.5	17.3	13.2	65.6	100
Value added by manufact., per cent	2.6	7.0	16.6	11.5	62.3	100	0.3	2.6	14.0	13.0	70.1	100
Wages paid, per cent	3.2	8.7	18.9	12.3	56.9	100	0.5	3.7	15.3	13.6	66.9	100
Salaries, rents, contract work, federal and state taxes, per cent	0.1	1.8	12.7	12.8	72.6	100	2.1	5.7	14.9	11.0	66.3	100
Residue (net), per cent	2.3	5.8	15.2	11.2	65.5	100	0.0	1.3	12.4	12.1	74.2	100

Machinery

machine tool builder caught short of cash in a depression is in an extremely dangerous position. Clearing a stock of machine tools by a bargain sale is decidedly different from clearing goods that can be sold to millions at a bargain price. Even small distress stocks can be moved only at ruinous prices. Potential users of a given size and make of machine are few and scattered, even in times of active demand. In a depression, demand from even these few potential users shrinks to a small percentage of what it was at the height of the boom.

Not only is the period of carry-over likely to be long, but another danger of carrying large stocks must be reckoned with. That danger lies in obsolescence of designs. Necessity is the mother of invention, and the necessity of getting work for idle shops always produces a goodly number of new and improved designs after a depression has lasted for some time. When these are brought forth, their greater utility to the user kills the demand for the older types. In a depression, machines of new design can generally be made for less than the old types had cost in the boom. Even if not obsolescent, the replacement cost of the older type is less in a depression than in a boom. Some competitor who has no knowledge of unchangeable economic facts is almost certain to conceive the bright idea that by making very low prices he can get a much larger participation out of a dull market than his natural participation had been in a more active market. He thinks he can thereby carry some of his overhead at his competitors' expense. But as the competitors are not asleep, this bright idea fails to bring the anticipated results. All have a natural desire to keep their own places in the sun, and they meet his low prices and all get that much less to carry overhead with. While all these factors lead to great losses in a depression, the low prices do not lead to any appreciable stimulation of sales.

Low Prices do not Stimulate Machine Tool Demand

For fifteen months in the last two years, machine tool volume was down to less than 15 per cent of what it had been in the first quarter of 1920. For thirty-two months past, the demand has averaged about 23 per cent of that figure. In some cases, prices were made that would just about cover material and labor, in attempting to coax out orders enough to hold a force of good men together; but it was probably fortunate for some that their customers were not so keen for bargains as to fill up their shops at the low prices. Some people think that because the demand for cheap automobiles can be stimulated by slight reductions in price, the demand for machine tools acts in the same way; but there is a difference. The cheaper the automobile, the wider is the stratum of demand it can tap, until a saturation point is reached. On the other hand, a man who has just gorged himself with an elaborate dinner, cannot be coaxed by bargain prices to sit down immediately to another one. Machine tool buyers, in every boom, simply become fed up. Then the machine tool builders must wait in patience until their customers regain their appetites for more machines.

Necessity for Reserves in the Machine Tool Business

Because of these long periods of depressions through which the machine tool builder must carry his plant and organization, he must put a heavy "stand-by charge" on his goods. He must cover this cost of necessary idleness over which he has no control, by accumulating a reserve in good times out of which to draw in bad times. That reserve is cost, not profit. If he does not have such a reserve, he goes out of business by the bankruptcy route. Investigation shows that several representative machine tool companies did not earn quite 9 per cent on their investment for ten years preceding the war, although they made a large part of the total output. All of those earnings could not be taken out in cash dividends. Most of the earnings were reserves to carry over depressions.

Before the war, machine tool prices were very low, compared to the utility they gave their buyers. The prices advanced with the war, but advanced far less than prices of most goods. The earnings of the industry were good, but because of larger production, not because of excessive prices. The tax laws penalized the industry unjustly. The machine tool builders financed their own expansion, instead of asking the Government to do it. They now find themselves with expanded capacity that is much too large for any demand likely to arise in a few years. The pre-war demand was largely foreign, and is now very small. Likewise the rapid growth of the automobile industry required many machine tools that have now been supplied. The second-hand market has been glutted with all sorts of tools from dismantled war shops. All these factors have combined to make the machine tool business a very difficult one for nearly three years.

After the last boom, abuses by machine tool buyers became so common that the industry is now determined that in order to protect the industry and its honorable, considerate customers, steps must be taken to make available to the industry full information regarding those who use unfair methods of various sorts. The responsible, reliable machine tool builder will hereafter take an order to be a contract, not a buyer's option subject to cancellation. He believes in a price that is right all around, right for the customer, right for his own stockholders, for his employes, and for himself. He believes in the same price for all his customers, without discriminatory shading.

Planning for the Future

As a result of the depression of 1921 and 1922, the wide awake machine tool builder is giving close attention to the economics of his industry, and the nature of his demand. He is contributing statistics whereby the stages of his cycle are disclosed. In his mind he is correlating his shop as a part of the industry, and his industry as a part of the big industrial machine that turns out goods of all kinds for the world's comfort. He realizes that his is one of the intermittent gears in the machine, and that as long as the other elements of the machine compel him to work so much more slowly at times, he must regulate his finances so as not to get caught in a squeeze. Such correlation will make a better industry with sounder, saner conditions than the machine tool builder has ever known, either in booms or depressions.

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MACHINE TOOL MEETING IN PHILADELPHIA

A meeting was held on February 27 at the Engineers' Club, Philadelphia, under the joint auspices of the Engineers' Club, the Philadelphia section of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. At this meeting four papers of special interest were presented, as follows: "The Influence of Differences in Design of Milling Cutters on Power Consumption and Capacity," by James A. Hall, associate professor, Brown University, and Benjamin P. Graves, milling machine engineer, Brown & Sharpe Mfg. Co.; "The Design and Manufacture of Large Machine Tools," by George H. Benzon, Jr., engineer, William Sellers & Co., Inc.; "The History of the Machine Tool and its Effect on Present-day Civilization," by Dexter S. Kimball, Cornell University; and "Some Features of the Economic Situation of the Machine Tool Industry," by Ernest F. DuBrul, general manager, National Machine Tool Builders' Association.

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According to Technical Paper No. 287, recently issued by the United States Bureau of Mines, the aluminum copper alloy containing 92 per cent of aluminum and 8 per cent of copper, known in the trade as No. 12, will average an ultimate strength of 18,000 pounds per square inch and have an elongation of from 1 to 1.5 per cent in 2 inches.

PRODUCTION OF MACHINE TOOLS IN 1921

(COMPILED BY THE BUREAU OF CENSUS, WASHINGTON, D. C.)

	Number of Machines	Value
Total value for the United States	.....	$67,729,363
State Totals		
Ohio	.....	19,399,794
New York	.....	8,952,833
Rhode Island	.....	6,410,844
Pennsylvania	.....	5,927,283
Connecticut	.....	5,418,035
Illinois	.....	4,670,337
Massachusetts	.....	3,588,172
Michigan	.....	3,004,750
Wisconsin	.....	2,399,939
Indiana	.....	2,291,277
New Jersey	.....	2,197,488
Vermont	.....	1,611,440
All other states	.....	1,857,171
Totals for Different Types of Machine Tools		
Bending machines	54	164,315
Boring machines		
Horizontal	632	1,340,106
Pennsylvania	304	554,976
Ohio	58	478,289
All other states	270	306,841
Vertical	266	1,840,792
Ohio	100	590,711
Pennsylvania	44	489,847
Connecticut	93	472,621
All other states	29	287,613
Broaching machines	530	616,933
Drilling machines		
Multiple-spindle	676	1,106,097
Ohio	42	199,151
Michigan	35	58,086
All other states	599	848,860
Radial	722	1,360,233
Ohio	613	1,103,349
All other states	109	256,884
Sensitive	1,428	227,601
Ohio	283	36,969
All other states	1,145	190,632
Upright	1,677	603,156
Illinois	932	295,925
Ohio	324	217,553
All other states	421	89,678
Gear-cutting machines		
Automatic	656	1,445,672
Disk type	32	70,047
Generating type	146	182,524
Other types	6	38,424
Grinding machines		
Plain	1,789	1,666,101
Massachusetts	627	1,144,842
All other states	1,162	521,259
Universal	692	656,184
Surface	271	337,620
Massachusetts	93	147,290
Connecticut	20	100,126
All other states	158	90,204
Cutter, tool and knife	435	319,396
Massachusetts	129	78,369
Ohio	80	73,759
Connecticut	71	53,201
All other states	155	114,067
Internal	276	345,029
Other types	208	69,136
Wisconsin	179	50,996
Connecticut	14	10,453
All other states	15	7,687
Hammers		
Drop	502	120,139
Pneumatic	2,607	814,394
Other types	541	179,171
Lathes		
Engine	5,117	5,229,884
Ohio	2,060	3,112,191
Indiana	1,346	396,707
New York	381	277,739
Massachusetts	106	229,471
Illinois	350	226,578
Pennsylvania	67	56,892
All other states	807	930,306
Bench	1,095	393,112
Massachusetts	305	131,852
Illinois	423	123,946
Connecticut	56	21,995
All other states	311	115,319
Turret	1,077	1,580,842
Ohio	594	786,014
Indiana	237	394,612
All other states	246	400,216
Other types	333	1,440,017
Planers	194	1,271,824
Ohio	95	542,113
Pennsylvania	27	154,662
All other states	72	575,049
Milling machines, hand feed	468	233,945
Connecticut	324	120,643
All other states	144	113,302
Milling machines, power feed		
Plain	536	812,346
Ohio	232	361,116
All other states	304	451,230
Universal	594	1,092,234
Ohio	220	364,939
All other states	374	727,295
Vertical	212	415,275
Ohio	110	243,600
All other states	102	171,675
Lincoln type	32	32,997
Planer type	173	696,685
Other types	258	539,776
Ohio	36	40,125
All other states	222	499,651
Pipe machines	1,192	570,509
Ohio	631	349,497
All other states	561	221,012
Portable tools		
Drilling	20,809	1,886,978
Ohio	5,814	956,918
Michigan	10,557	453,560
All other states	4,438	476,500
Other types	411,642	2,593,633
Presses		
Punching	20,045	7,284,166
New York	14,325	5,147,848
Ohio	3,716	1,467,893
Wisconsin	185	67,936
All other states	1,819	600,489
Other types	3,783	1,643,244
Screw machines	2,661	2,839,667
Ohio	560	609,435
All other states	2,101	2,230,232
Shapers	1,418	1,020,342
Ohio	822	485,770
Connecticut	256	156,597
Pennsylvania	6	16,250
All other states	334	361,725
Shears	3,347	906,722
Ohio	289	229,711
Wisconsin	50	105,038
Illinois	24	42,852
All other states	2,984	529,121
All other machine tools	.....	5,486,336
Connecticut	.....	1,256,578
Ohio	.....	702,922
Pennsylvania	.....	407,719
New York	.....	176,934
Illinois	.....	101,344
Missouri	.....	100,696
Michigan	.....	95,268
Massachusetts	.....	63,854
All other states	.....	2,581,021
Parts and attachments	.....	8,936,547
All other products	.....	7,319,212

Machinery

The Machine-building Industries

IN the month of January, the definite upward trend in business continued in practically all fields. The machine tool industry followed this trend. Business in this field has steadily increased for the last six months, until in several cases, it is now fully equal to, or greater than, pre-war business. Even when compared with business during the peak period, the progress is satisfactory. New orders in the industry during January averaged, as expressed in dollars, nearly one-half the average monthly business of the first three months in 1920. But as prices are much lower now than they were then, the actual volume of business, expressed in number of machines sold, is over 50 per cent of the peak volume.

This new business is well distributed over different industries, and with few exceptions machine tool builders agree that January was their best month in two years. Several dealers state that the machine tool business is better than 50 per cent of normal. The demand for new machines is increasing, and the call for second-hand machines is falling off—a decidedly good sign. Unfortunately, there are still a few shops for whose product the demand is very limited, as present manufacturing activity produces no demand for certain special lines of machine tools. On the other hand, shops manufacturing heavy machinery, especially for railroad and locomotive shops, are quite busy, and in both the machine tool and the small tool fields the automobile industry is one of the most active buyers. Generally speaking, the small tool plants operate at from 50 to 70 per cent capacity. Some of the manufacturers in this field state that if their plants are occupied at two-thirds capacity, they consider their business normal.

The difficulties that harass the manufacturer and shipper today are due primarily to car shortage and lack of coal, especially in New England. There is also a scarcity of good machinists and toolmakers, which is more and more definitely felt as the shops grow busier. A decided labor shortage is developing in those parts of the country where the steel industry is concentrated, and a tendency to compete actively for labor is in evidence. The great necessity for a definite program for training machine shop workers becomes more and more apparent.

The Iron and Steel Industry

Activity in the iron and steel industry points to continued activity in the machine building industries for a considerable period. There were only two months during the busy year of 1920 when the average daily production of pig iron exceeded the average for January, 1923. The pre-war peak production was 91,000 tons a day, and the January figure was 104,000 tons, which is not far short of peak production for any one month, which was 114,000 tons a day. As a matter of fact, in 1917, when the production of pig iron was forced to the utmost because of the war, the average daily production was only a trifle in excess of that in January. This is the most definite sign of returning normal business in the machine building, machine tool, and small tool fields, to which we can point.

The demand for steel grows steadily, and is more generally distributed than at any other time in recent years. Electrical machinery manufacturers, railroads, automobile companies, and the building construction industries are all pressing the mills for deliveries. Orders for steel railway cars are the heaviest since 1916, and a continuance in the building boom this spring is forecasted by the increased sale of fabricated steels. The United States Steel Corporation is working at over 88 per cent capacity—the highest in several years. The operations are not expanding as fast as the steel manufacturers desire, to take care of the heavy volume of orders placed, because there is a marked shortage of labor in the steel districts. Slight increases in prices have been made, and in some districts pig iron has advanced. We mentioned in February MACHINERY that, in view of possible price advances, this was a good time to place orders for materials, and subsequent events have justified this statement.

Tractors and Farm Machinery

One of the quietest fields is that of farm implements and machinery. Not much improvement can be seen in these industries, and the tractor business is comparatively slow. There are definite indications, however, of a fair amount of buying by the farmers this spring, which will deplete the stocks now on hand and make it possible for the farm implement and machinery industry to start manufacturing for new demands. In many cases, dealers' orders for 1923 are far ahead of present factory schedules, which necessarily means increased activity in the agricultural machinery shops before long.

The Automobile Industry

Automobile production continues to be heavy—in fact, it is heavier than ever before at this time of the year. Ford is maintaining a production of over 100,000 cars a month, and other automobile builders are equally optimistic. The production schedule of the Studebaker Corporation calls for 48,000 cars for the second quarter of the year, as against 35,000 cars during the first three months. This company expects to build 150,000 cars in 1923, as compared with 110,000 cars in 1922.

On the basis of an average expenditure of $600 by each car owner annually, and 13,000,000 motor vehicles registered in the United States at the end of 1923, George W. Hinman of Chicago estimates that $7,800,000,000 will be spent on automobiles this year. This is twice the cost of our national government, and gives an impressive exhibit of the proportions of the automobile industry.

The Business Outlook

A review of authoritative business opinions as to the industrial outlook at this time may be of interest. The Federal Reserve Bank of Cleveland says, "Business has discarded most of its hesitating attitude. In its place is a spirit of confidence. Aside from the foreign situation there is little in the conditions outside of business that will prevent the continuance of good business. In many ways this will be a critical year, a year when effective management, sales efforts, better salesmen, more intensive training, and harder and more conscientious work will be necessary."

The Department of Commerce states that "well sustained business and industrial activity is shown by the figures compiled by the Department." These Commerce Reports indicate, particularly, continued activity in the textile field, building, and pig iron production, and improvements in the transportation situation and coal production, with but a slight decline from last summer's peak in the output of the automobile industry. "On the whole a bright outlook for the immediate future, so far as domestic trade and industry is concerned, is seen by the Department in these statistics. The disturbed foreign situation has so far appeared to have but little effect."

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Heald Internal Grinding Machines

An automatically operated internal grinding machine with a hydraulic table drive, a new wheel-head drive for application to several types of internal grinding machines, and two automatic and hand-feed internal grinding machines equipped with two wheel-heads have all been added to the line of grinding equipment manufactured by the Heald Machine Co., 16 New Bond St., Worcester, Mass. The first mentioned of these new products is the No. 72 machine illustrated in Fig. 1. In this machine the table travels in a vee and flat way, the hydraulic drive being actuated by oil. Any speed from nothing to maximum may be instantly obtained. The hydraulic mechanism is controlled by an automatic valve located at the front of the base. By means of a stop, it is possible to maintain or return to any particular speed without even looking at the speed-change lever. No gears are used in the construction of the machine.

The lower part of the base serves as an oil reservoir, and is completely enclosed. By this construction the weight of the oil supply adds to the stability of the equipment. The work-head has a hardened and ground steel spindle running in dustproof, adjustable bronze bearings. A friction clutch on the inside of the spindle driving pulley is engaged by a lever, and the water supply is either started or stopped simultaneously with the operation of this lever. The work-head is mounted on a bridge, which, in turn, is bolted directly to the base. The head can be swiveled up to 45 degrees for grinding tapers, and is graduated in degrees and taper per foot. There are five changes of work speeds.

The cross-slide carries the wheel-head and a flexible idler drive. A positive stop is provided on the slide to enable the operator to grind to any given size without watching the dial, and the slide is also arranged with a fine adjustment to compensate for wheel wear. A close-up view of the wheel-head and flexible idler drive is shown in Fig. 3. This drive is applicable to the Nos. 70, 72, 75, 80, and 85 machines

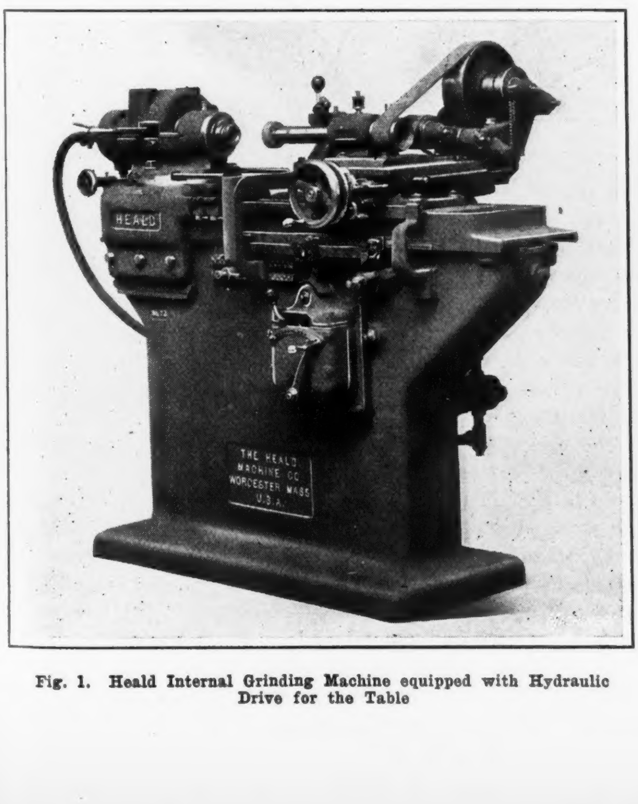


Fig. 1. Heald Internal Grinding Machine equipped with Hydraulic Drive for the Table

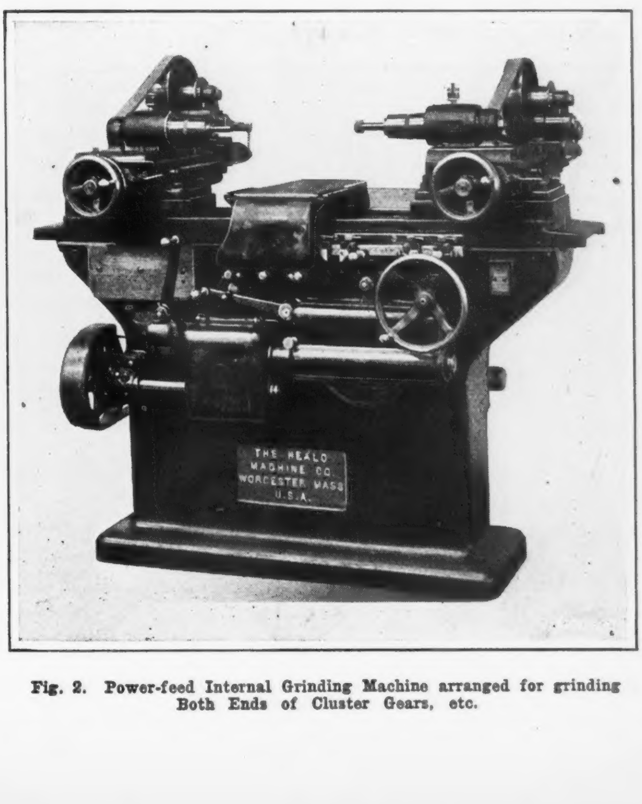


Fig. 2. Power-feed Internal Grinding Machine arranged for grinding Both Ends of Cluster Gears, etc.

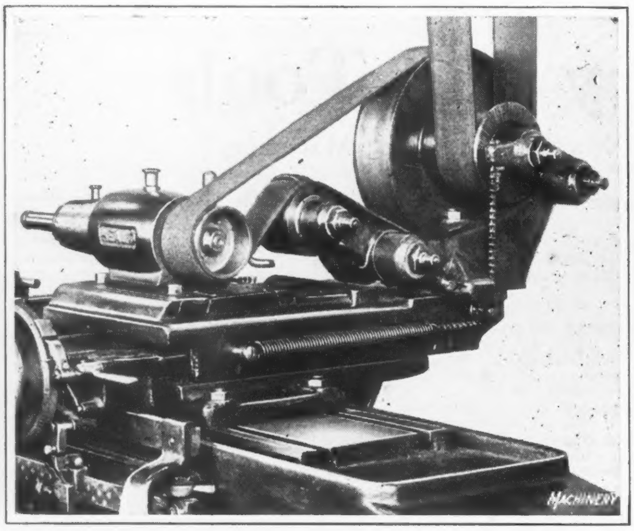


Fig. 3. Close-up View of Wheel-head provided with New Type of Idler Drive

manufactured by this concern. The flexible idler is interchangeable with the old style of idlers.

The advantage claimed for this wheel-head drive is greatly increased production. In one particular case, a piece of Shelby steel tubing, 2½ inches in diameter by 9 inches in length, having a wall thickness of ⅛ inch, formerly required twenty minutes for finishing. With the same method of holding the piece and the machine tended by the same operator, the new drive is said to have cut this time down to eight minutes. The width of the belt connecting the driving shaft to the large pulley has been increased from 2 inches to 3 inches, and the belt connecting the large pulley to the wheel-head pulley from 1½ inches to 2½ inches. The arc of contact on the wheel-head belt has also been increased from 45 per cent to 85 per cent, by employing a spring-tension belt-tightener, which not only gives additional belt traction, but also reduces the strain on the wheel-head bearings.

The wheel-head can be furnished in nineteen sizes for the No. 72 machine. The different sizes are interchangeable, so that the operator may have the proper size of spindle for the job in hand. The wheel-truing device is of a design which insures grinding a hole to any predetermined size without gaging. The device can be quickly dropped into and out of the truing position. The machine swings work up to 15 inches in diameter, and grinds to 11 inches in depth. Work up to 12 inches in diameter can be swung inside the standard water guard.

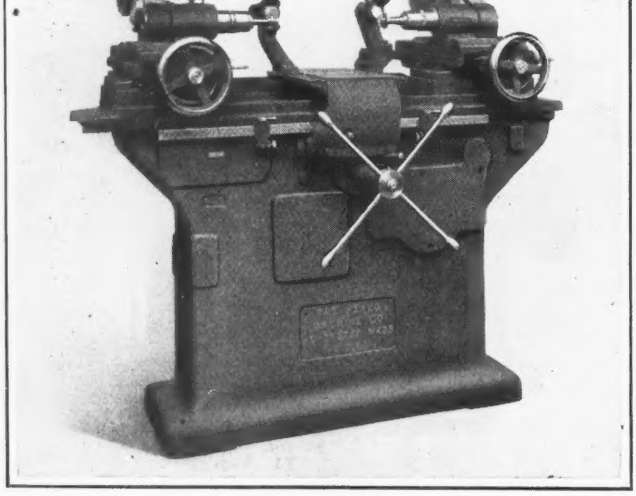


Fig. 4. Hand-feed Type of Machine also equipped with Two Wheel-heads like the Machine in Fig. 2

The automatic and hand-feed internal grinding machines, equipped with two wheel-heads for grinding the hole in cluster gears and similar parts where both ends of the hole must be in line, are illustrated in Figs. 2 and 4. The two heads are mounted on opposite ends of a special table, at the middle of which there is a bridge. The work is held and revolved in a special fixture, which rests on this bridge. Each wheel-head has an individual drive and adjustment to permit grinding from both ends of similar or different holes with or without shoulders. The power-feed machine is generally preferred for long holes without shoulders, while the hand-feed machine is found especially satisfactory for short holes. The heads are equipped with the idler drive shown in Fig. 3. The diamond truing device is illustrated on the hand-feed machine. It is of the swinging type, which permits of truing the wheel without disturbing its relation to the work. These machines are being used for grinding bearing cages, automobile wheel hubs, and countershafts, in addition to cluster gears.

BLANCHARD AUTOMATIC SURFACE GRINDING MACHINE

A surface grinding machine that automatically grinds work to size, measures it, controls the adjustment of the wheel-head, and finally unloads and demagnetizes the work, with-

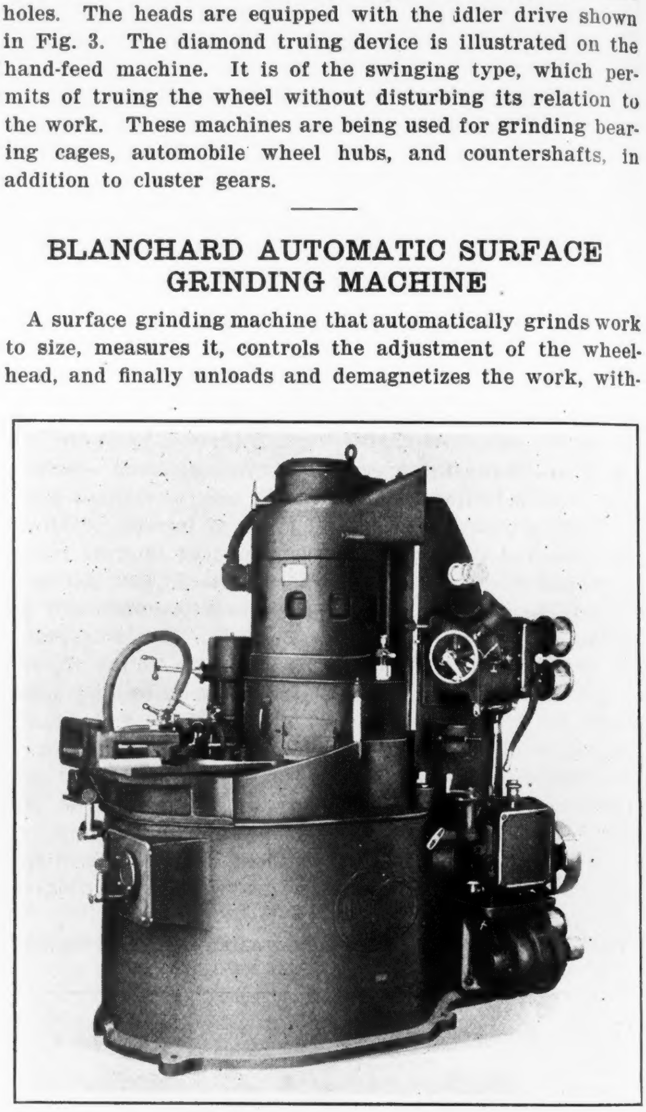


Fig. 1. Blanchard Automatic Surface Grinding Machine

out any attention on the part of the operator, is being placed on the market by the Blanchard Machine Co., 64 State St., Cambridge, Mass. It is known as the No. 16-A automatic surface grinding machine. An automatic washing equipment may also be provided, so that the work will be delivered to holding receptacles washed as well as demagnetized. The operator's duty consists simply of standing at the loading station and laying the work on the continuously revolving magnetic chuck.

The operation will be understood by following the course of a piece through the machine. At the position where the piece is laid on the magnetic chuck, there is no magnetism, the work starting around with the chuck by being held on it by its own weight. Just before the piece reaches the water guards it is held magnetically on the chuck, and as it passes through an opening in the guards it is carried under the grinding wheel. The latter has been accurately adjusted to the proper height by preceding pieces. The piece is ground to size as it passes under the wheel, and it is then

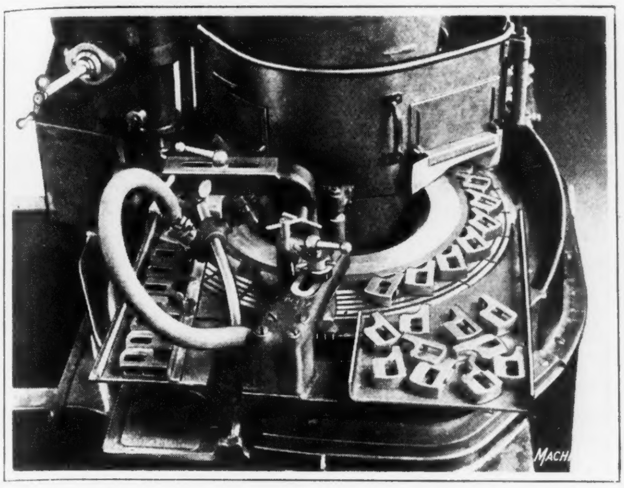


Fig. 2. Close-up View of the Position where Work is placed on the Magnetic Chuck

carried through the water guards and under a caliper, which automatically sets the grinding wheel to compensate for any wear that has occurred.

When the caliper has been passed, the part of the chuck on which the particular piece is being carried again becomes non-magnetic, thus permitting the piece to leave the chuck. It then passes through a demagnetizer and down a chute to suitable receptacles. When the piece has been removed, this part of the chuck surface is washed with water and then cleaned, so that it is clean and dry when it again reaches the loading position.

In this continuous grinding operation, the pieces are placed one after another on the chuck to form a continuous chain of work, as illustrated in Fig. 2. When grinding up to 1200 surfaces per hour, only one operator is necessary per machine, but when producing a greater quantity, one helper may be needed part of the time. One helper can serve three or more machines.

The magnetic chuck is of one-piece steel construction, and absolutely waterproof. Magnetization of the chuck under the wheel and caliper only is accomplished in a simple manner, without the use of sliding or moving contacts. The wheel-spindle is supported on ball bearings throughout, and is heavily constructed. The demagnetizer is connected to the motor circuit, and thus starts and stops with the motor. All controls are placed within convenient reach of the operator, and all important bearings and gears are lubricated by oil baths. Water guards prevent splashing and spraying of the coolant. The base forms a tank for 180 gallons of coolant, and also acts as a settling tank from which chips may be removed while the machine is in operation.

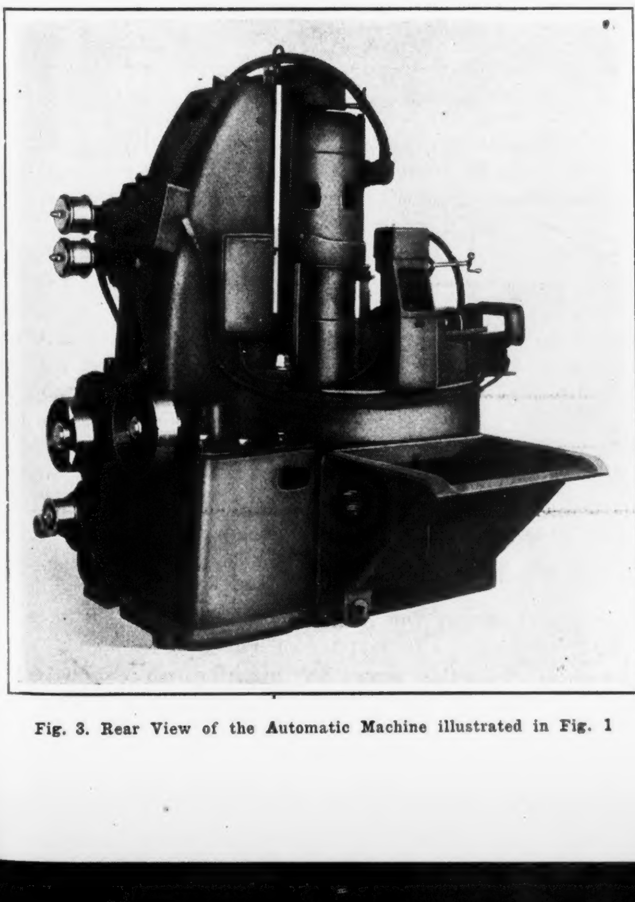
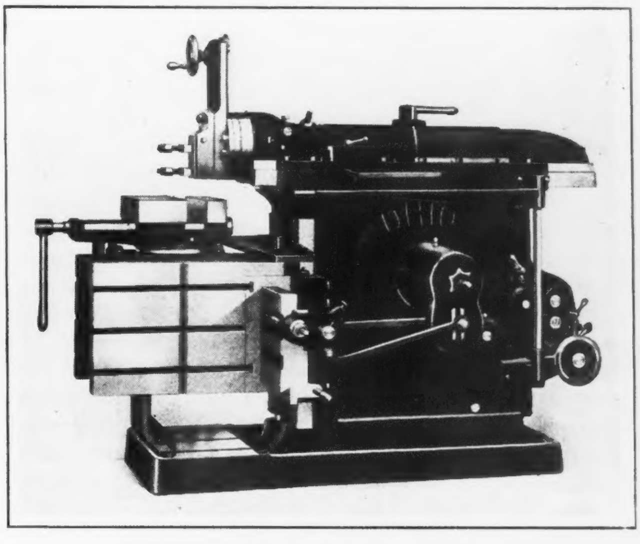


Fig. 3. Rear View of the Automatic Machine illustrated in Fig. 1

OHIO "DREADNAUGHT" CRANK SHAPER

Particularly severe work in which metal must be removed rapidly and accurately is the class of service for which the "Dreadnaught" shaper, here illustrated, has been developed by the Ohio Machine Tool Co., Kenton, Ohio. It is claimed that the maximum width and depth of cut can be taken at each stroke without stalling the machine, as the column, rail, ram, and other important parts have been generously proportioned to meet this requirement. The machine has a stroke of 32 inches, and is equipped with a large diameter pulley having a wide face.

The back-gear ratio is 28 to 1, and the crank-arm is 42½ inches long. The latter dimension brings the center of the bull gear considerably above the center of the crank-arm, which is said to be a factor in obtaining the high power of the machine. The ram bearing is square, and cannot wedge into the column bearing, as the ram bearing surface is sufficiently high to resist the pressure exerted. This bearing of the ram is 2½ inches high, while the width of the ram is



"Dreadnaught" Heavy-duty 32-inch Crank Shaper

13 inches, and its length 62 inches, not including the harp or tool-box. The front end of the ram is 11 inches outside diameter. The design of the machine is such that even on full strokes a large proportion of the ram remains in contact with the column bearing. All control levers are located on the operator's side of the shaper, so as to permit quick set-ups and adjustments. The machine can be arranged with either a single-pulley belt or a motor drive. The down power-feed mechanism shown on the machine is an extra attachment.

HARTNESS MODIFIED SCREW THREAD COMPARATOR

A slight modification has been made in the Hartness screw thread comparator manufactured by the Jones & Lamson Machine Co., Springfield, Vt., to adapt it for the inspection of gears and other parts having irregular profiles, in addition to the inspection of screw threads. The capacity of the comparator is also increased so as to accommodate both small- and large-diameter threaded parts and gears up to 20 inches in diameter. With gears or large profiles where a low-power lens is necessary, the shadow is projected on a 20- by 24-inch mirror, which is silvered on its front face and

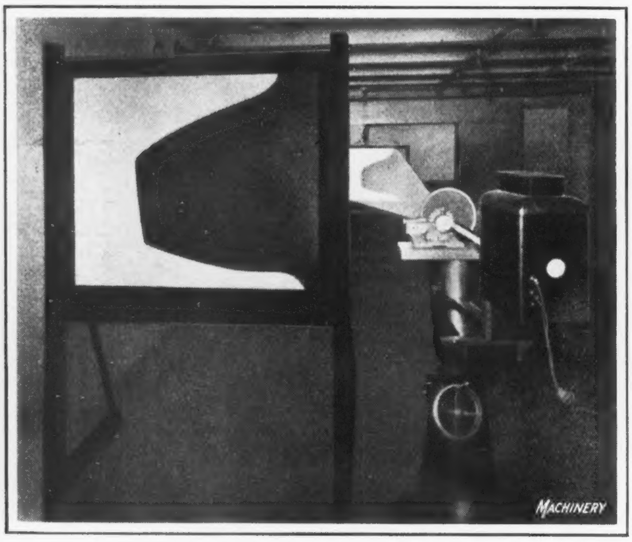


Fig. 1. Using a Modified Hartness Screw Thread Comparator in studying a Tooth Profile

then reflected back to a 36- by 44-inch ground glass screen at the side of the machine. With this arrangement, as the operator manipulates the work, he has the advantage of observing a large shadow at a convenient distance from his eye. Thus he may readily study the profile of the work, as illustrated in Fig. 1, or the rolling action of gear teeth, as shown in Fig. 2. The photographs from which these illustrations were reproduced were necessarily somewhat indistinct because of the dimly lighted room in which the equipment is used.

The machine is built with a work-table, 18 inches long by 7 inches wide, which can be compounded 45 degrees either side of the center. The entire light source and lens system is in a self-contained unit, which rides vertically on a 5-inch diameter column, the movements of the unit being controlled by a rack and pinion device. The machine is equipped with a fixture for mounting centered work, taps, gages, or hobs. When a hob tooth is projected into a true outline on the screen, any error in form can be readily detected. A size block may then be inserted between a stop in the carriage and a micrometer anvil in the base. Then a tooth spaced equal to the thickness of the size block should fall into the outline on the screen. If the lead is long or short, the shadow will be displaced from the outline an amount equal to the error in pitch.

Production screws are inspected in the same manner as on the original Hartness screw thread micrometer, that is, with the screws mounted in cradles and the thread projected into a tolerance chart which is located five feet from the operator, and which is enlarged 200 times. The machine may be supplied with either an incandescent lamp or a carbon arc for use as a light source. Specially designed lenses are necessary to meet this problem of projecting irregular shaped opaque objects on a screen. These lenses can be supplied in three powers.

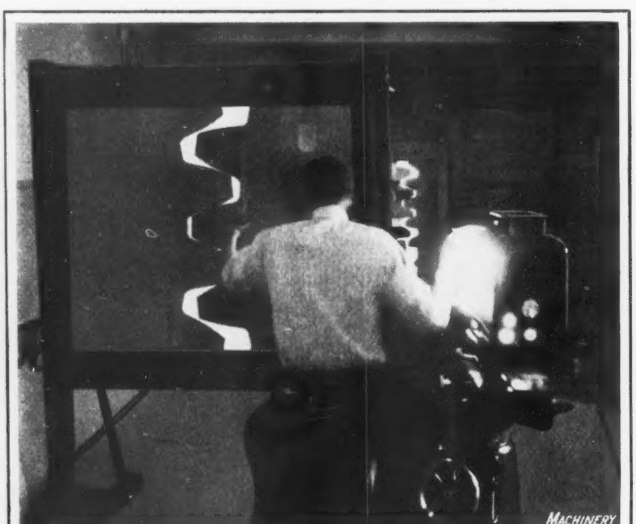


Fig. 2. Method of observing the Rolling Action of Gear Teeth by Means of the Comparator

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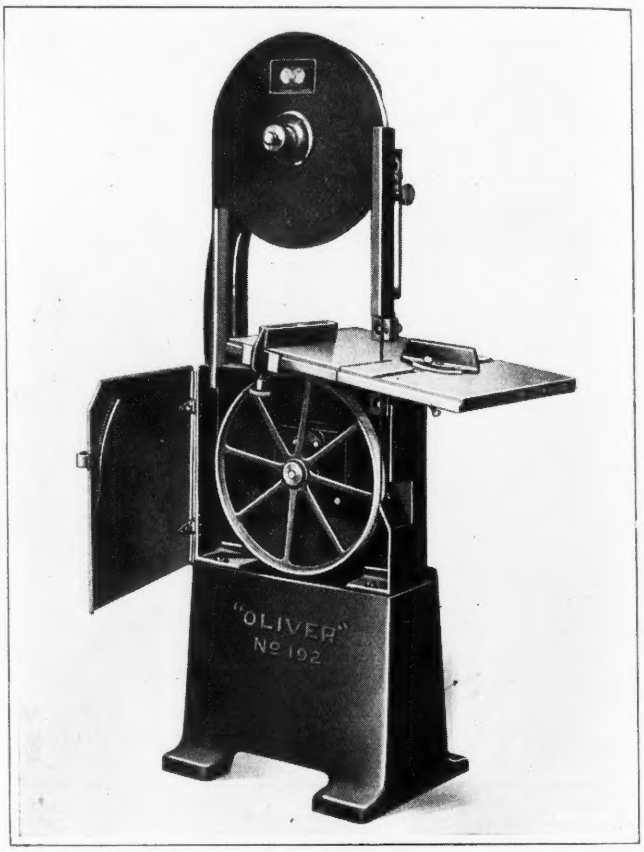
OLIVER BAND-SAWING MACHINE

A large cast-iron tilting table, miter cross-cut gage, and parallel ripping fence are special features of the No. 192 band-sawing machine built by the Oliver Machinery Co., Grand Rapids, Mich. This machine is an 18-inch size, being equipped with wheels 18 inches in diameter, and having a clearance space of 18 inches between the saw and the column. The machine may be supplied with either a belt or motor drive, and in either case it is a self-contained portable equipment. Current for a motor-driven machine may be obtained from any lamp socket. The motor is of 1/3-horsepower capacity, runs at a speed of 1800 revolutions per minute, and is mounted on a bracket attached to the left-hand side of the machine. The lower wheel shaft is driven through reduction gearing, directly connected to the driving shaft.



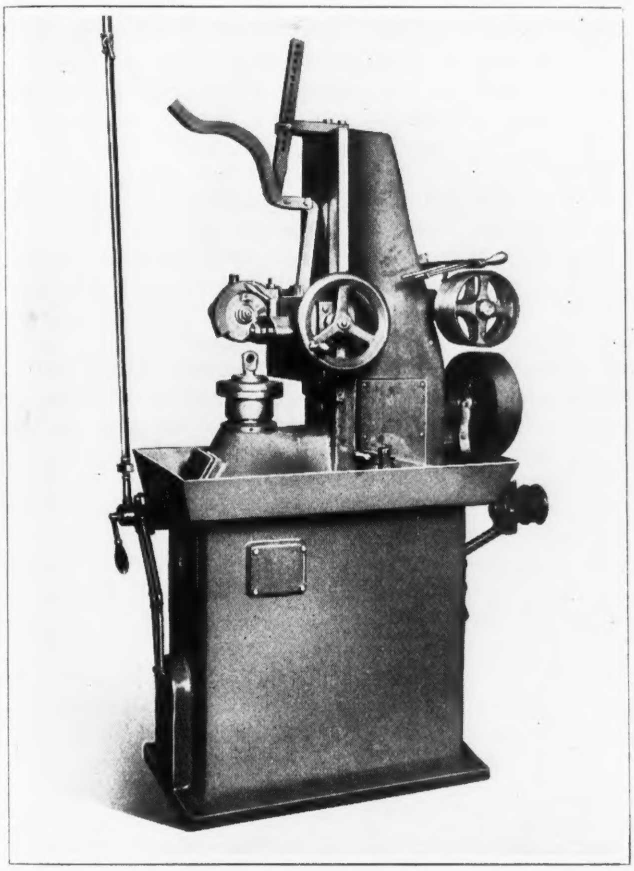
Oliver Portable Band-sawing Machine

Saws up to ½ inch in width are ordinarily used on this equipment, and by using the gages, work up to 11 inches in width may be ripped, and work to 8 inches in width may be cut off and mitered. The table can be tilted up to 45 degrees. Frictionless roller guides are furnished both above and below the table. The machine is adequately guarded by means of a hinged steel door which covers the lower wheel, two circular steel guards which cover both sides of the upper wheel, a U-shaped steel guard which encases the rear part of the saw, and a U-shaped cast-iron guard which covers the front part of the saw that is not actually cutting. The last-named guard is adjustable in relation to the guide post. The machine can also be furnished without the floor base, for mounting on a bench.

PISTON TURNING, FACING, GROOVING AND GRINDING MACHINE

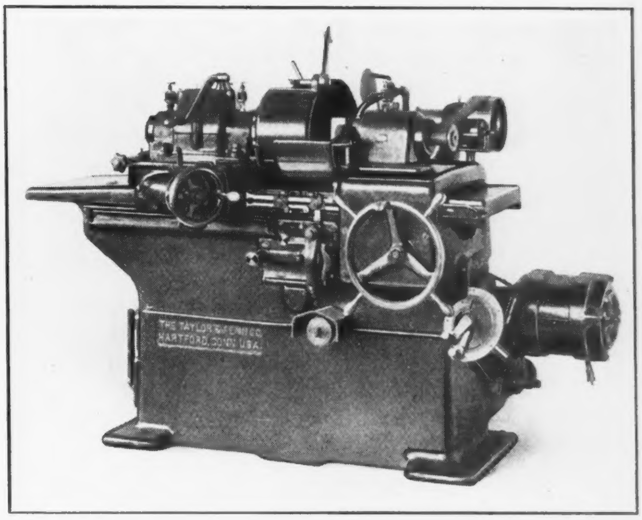
Various operations necessary in manufacturing automobile pistons may be accomplished on a machine now being brought out by the Production Machinery Co., Jackson, Mich. As illustrated, the machine is set up for taking a finishing cut on the closed end of a piston by employing an ordinary tool, and afterward grinding a highly finished surface on this end of the piston by using a grinding head. However, the machine can also be used for boring and facing the open end of the piston, rough- and finish-turning the walls, rough-facing the closed end, and rough- and finish-grooving. It may also be employed for machining fan pulleys, wheel hubs, etc.

All the mechanism pertaining to the operation of the machine comprises one unit. The speed-change mechanism, clutches, spindles, and driving mechanism are contained in the upper half of the machine, which comes apart just below the chip pan. By means of this construction, four or five machine heads can be placed on one base, when such an installation is desirable. Each of the heads so mounted will operate independently of the others. The machine may be supplied for either a direct lineshaft or motor drive.



Machine built by the Production Machinery Co. for manufacturing Pistons

The main driving shaft is located at the back of the machine, and is driven through a clutch pulley. From this shaft power is transmitted to the work-spindle through sliding change-gears that provide six speeds for this spindle. The latter is equipped with a Logansport air chuck. The machine may be furnished with either hand- or power-feed for the cutter-head, the hand-feed being employed on the machine illustrated. With the facing and grinding set-up shown on the machine, the head is fed by hand in one direction to traverse the facing tool over the work, and then fed in the opposite direction to bring the grinding wheel into action. This wheel is driven by a separate belt from the back of the machine. The main spindle bearing is bronze-bushed, and the thrust is taken by a ball bearing.



Taylor & Fenn Motor-driven Bore-grinding Machine of Improved Design

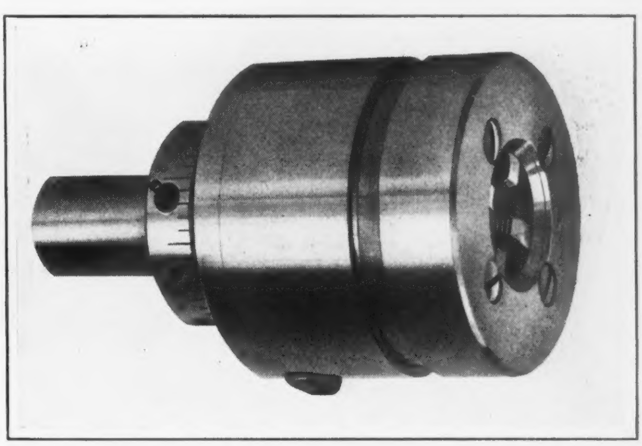
TAYLOR & FENN MOTOR-DRIVEN BORE-GRINDING MACHINE

A direct motor-driven bore-grinding machine of improved design is being placed on the market by the Taylor & Fenn Co., Hartford, Conn. In this machine the rotor is mounted on the driving shaft in place of the pulley supplied when the machine is driven by belt. The stator is supported by a special bracket securely attached to the change-gear box. By this construction, a compact and simple motor drive is obtained without requiring additional floor space. The complete equipment consists of a machine, motor, switch, and enclosed connecting wires. The driving shaft runs in ball bearings of heavy type, which are fully enclosed, and it is automatically lubricated.

An alternating-current motor of 5-horsepower capacity, running at a speed of 1200 revolutions per minute, is generally furnished. However, a motor of the direct-current type may also be supplied. Among the improvements made to the bore-grinding machine itself since it was first placed on the market is a control mechanism which insures a positive and accurate table reverse. The splash guards, with which the machine is equipped are of a new design and are ample to take care of a large volume of water.

MURCHEY SELF-OPENING DIE-HEAD

A Type O self-opening die-head of simple construction, especially adapted for use on automatic multiple screw machines, single-spindle screw machines, and automatic threading machines, is being placed on the market by the Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. This die-head is made in six sizes to accommodate work from 1/4 to 1 1/2 inches in diameter, but larger sizes can also be furnished. Adjustments to 0.001 inch can be made by merely



Murchey Self-opening Die-head for Automatic Screw Machines

loosening a set-screw on the ring and turning the ring. The operator can see clearly just what contraction or expansion has been made, and thus accuracy of settings is assured.

Every part in the die-head is carburized, hardened, and ground. The die trips instantly and positively, a trip with large bearing surfaces being provided so that constant tripping will not affect its efficiency. The hobbed chasers furnished with the die-head are said to insure threads accurate in lead and pitch. These chasers are made from high-speed steel and are specially treated during the cutting and hardening operations. The chasers and other working parts are enclosed to prevent chips from getting into the die-head and clogging its action. The chasers are backed against a hardened and ground steel ring, and their clearance is not affected by grinding or sharpening. The chaser slots are held within limits of 0.0005 inch.

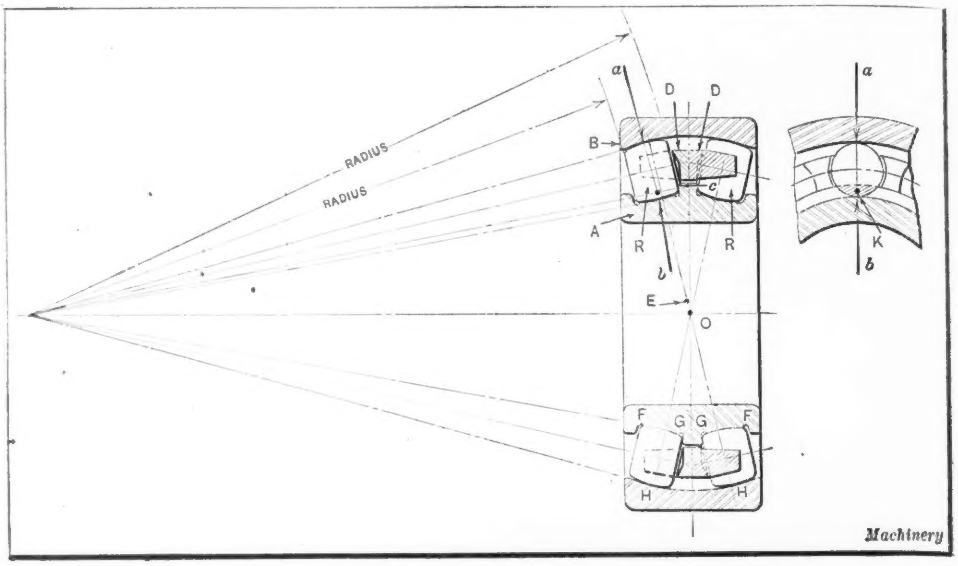


Fig. 2. Sectional View, showing Details of Construction of the Spherical-type Roller Bearing

S K F SPHERICAL TYPE ROLLER BEARING

A roller bearing that differs markedly from conventional types has recently been placed on the market by the S K F Industries Inc., 165 Broadway, New York City. This new design was developed to meet the demand for a bearing that would embody the desirable characteristics of both ball and roller bearings. Its especial field of application is heavy-duty service, such as is required of steam and electric railway journal boxes, railway motors, rolling and tube mills, flywheels, and hoisting machinery. In 1918 the S K F Co. of Gothenburg, Sweden, undertook to study the needs of this class of equipment, making extensive tests on different designs of bearings. The spherical type roller bearing illustrated in Fig. 1 is the result of this research.

Referring to the sectional view of the bearing, shown in Fig. 2, it is intended that the inner race *A* be secured to a shaft or journal according to the usual methods employed with ball bearings operating under corresponding load and speed conditions. The outer race *B* is ground spherical on the inner surface from the center point *O* of the bearing. This race should be mounted in a housing in the same way that a ball bearing is usually mounted, a slight clearance being normally provided to facilitate creeping of the race in the housing while in service. The bearing is a self-contained and self-aligning unit, internal adjustment being required of the bearing when it is being installed. The spherical surface of the outer race provides for self-alignment to compensate for shaft deflections and inaccuracies in machining and locating the housings.

The rollers *R* are barrel-shaped, and their largest diameter is toward the inboard end. On the inner race each roller contacts with a groove *FG* throughout its length, and so line contact of the roller bearing is established. On the outer race, the roller contacts at point *H*, and owing to the closeness of the roller curvature of radius *EH* with the race curvature of radius *OH*, the contact is intimate and comparable with that of the typical deep-groove type of ball bearing provided with a ball of very large diameter. Owing to the elasticity of these parts and the consequent deformation under load, there is a substantial area of contact between the rollers and the outer race. From this it will be seen that the spherical type roller bearing embodies the theoretical characteristics of both the point contact of the ball bearing and the line contact of the roller bearing.

Parallelism of the axes of the rollers with the axis of the shaft on which the bearing is mounted is maintained in a positive manner by means of a guiding flange on the inner race at *G*. Both sides of the flange and the ends of the rollers have ground spherical surfaces, with the center of their radius located at the point of intersection of the shaft axis and the axes of the rollers. Since the guiding flange and the roller ends have the same center and curvature, they contact over the area shown at *K* in the end view.

Arrows *a* and *b* represent the resultant forces on the roller from the outer and inner races respectively. They are inclined toward each other at a slight angle, which is the included angle of a cone circumscribing the roller. This means that there is a wedging force holding the roller in contact with the guiding flange and developing a reaction *c* at the center of the area of contact with the guiding flange. As soon as a roller skews in the slightest degree, there is no longer a contact area between the end of the roller and the guiding flange, the contact being then at a single point

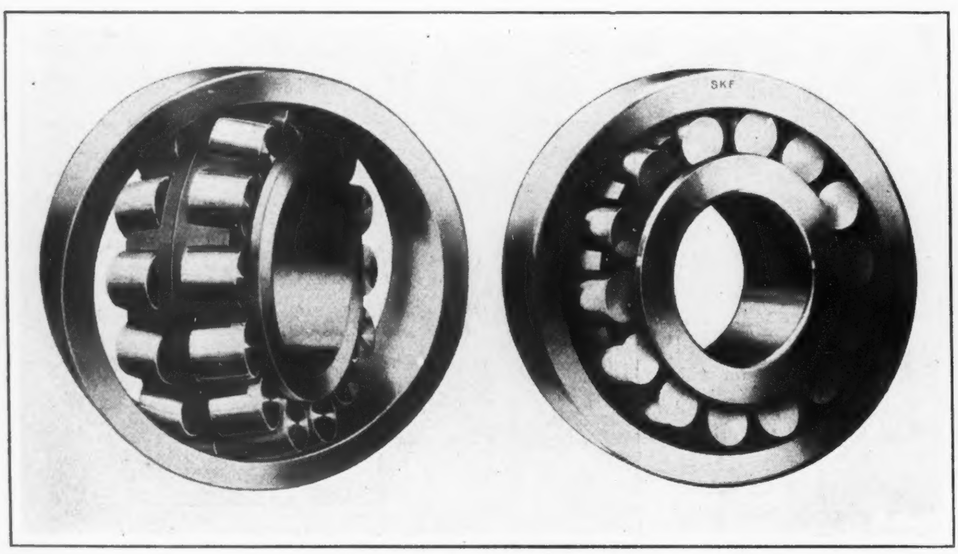


Fig. 1. S K F Spherical-type Roller Bearing

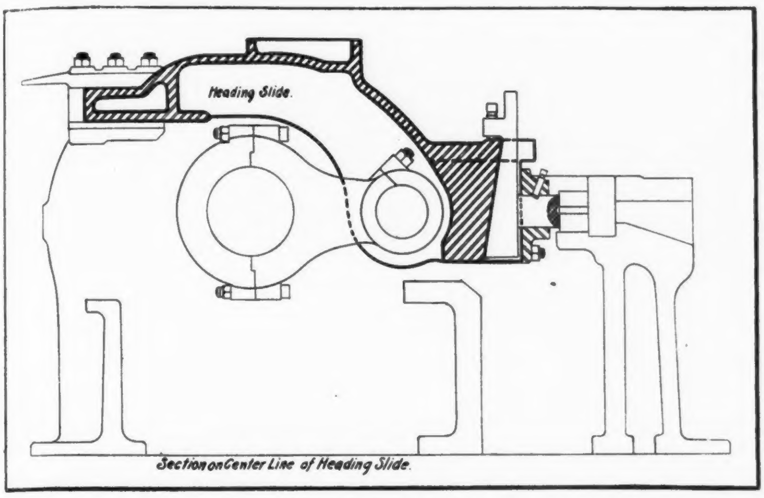


Fig. 1. Diagram of the Heading Slide and Bolster Plate Construction of the National Bolt and Rivet Header

on the edge of the roller. Then force *c*, together with the resultant of the inner and outer race reactions *a* and *b*, forms a couple which counteracts the skewing tendency and returns the roller to its proper position. The rollers are maintained in the proper relation with the shaft axis by this action.

Retainers *D* are carried on the land of the inner race, and serve only to prevent adjacent rollers from contacting with each other. The retainers are usually made of bronze, and are so designed that they hold the rollers from dropping out when the inner race is deflected relative to the outer race to permit of cleaning.

It is said that in equivalent sizes the spherical roller bearing has about twice the load capacity of the corresponding ball bearing. The thrust capacity is obtained by the angular contact of the load reactions *a* and *b*, and is not dependent on the guiding flange reaction *c*. The lubrication is similar to that of ball bearings under similar load and speed conditions. Oil is considered preferable, but grease may be used where conditions of design require it.

NATIONAL AUTOMATIC-FEED SEMI-HOT BOLT AND RIVET HEADER

After a thorough analysis of the factors contributing to the efficiency of automatically fed bolt and rivet headers, the National Machinery Co., Tiffin, Ohio, has developed an improved machine of radical design, which is now being placed on the market. This new machine is shown in Fig. 2. In the previous designs the amount of side pressure thrown on the gripping dies depended entirely upon the extent to which the operator introduced shimming or packing directly in back of the dies. As the relief devices were inoperative when the toggles were in the closed position, this packing resulted in destructive battering of the gripping die surfaces, and caused the edges of the impression to upset or turn in, thus necessitating frequent die changes. On the new design a patented automatic relief mechanism, while providing all the gripping pressure needed for the most difficult work, still limits the ultimate pressure obtainable and thus eliminates upsetting of the die faces and their premature deterioration from this cause.

The size of all bearings and working surfaces has been increased to enable the machine better to withstand hard service. All gripping toggles are located horizontally to insure proper lubrication, while a fully automatic system oils all bearings of the machine every ten minutes, supplying a predetermined amount of oil to each bearing in proportion to its service requirements. It is claimed that after a three-year test no machines of this type have required any repairs or realignment and that no working parts have showed signs of wear.

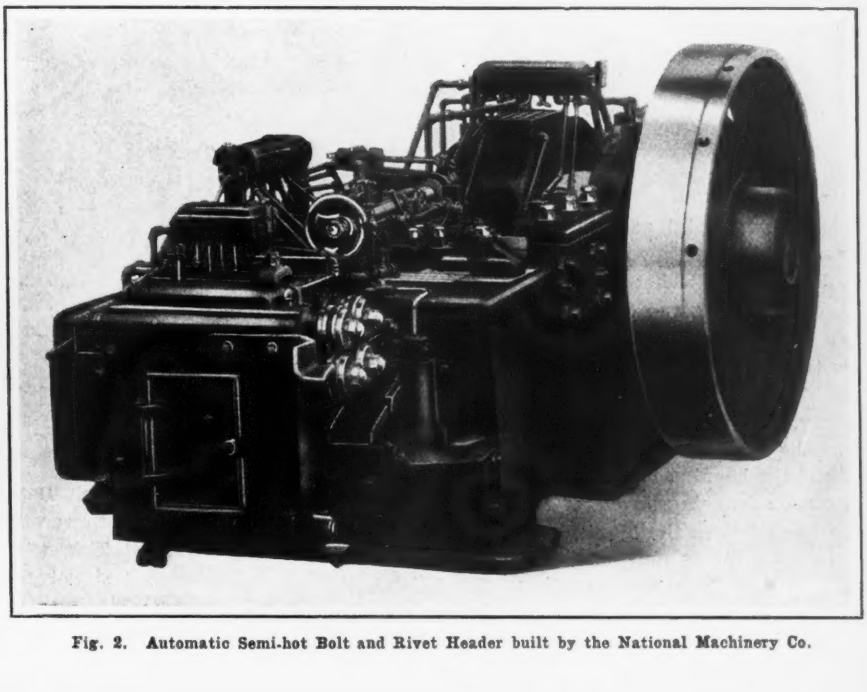


Fig. 2. Automatic Semi-hot Bolt and Rivet Header built by the National Machinery Co.

Previous trouble in die setting, which resulted from lack of horizontal adjustment for the heading tool, has been overcome by mounting the heading tool in a patented bolster plate on the front of the heading slide. This slide is screw-controlled in all directions to permit a quick and accurate adjustment of the heading tool with the gripping dies. Where hours were previously required in aligning the dies with the header, it is now only a matter of minutes. A diagrammatic illustration of the heading slide and bolster plate construction is shown in Fig. 1.

Three lengths of bolster plates are furnished, so that on all lengths of work, the tool may always be rigidly supported without overhang. The gripping or holding time may now be set to the exact requirements, by means of an adjustment in the gripping toggles. One result of thus limiting the length of contact with the heated stock is a reduction in the heating effect on the dies, and a consequent increase in the life of the dies. The breast-plate, shear, and gripping dies are water-jacketed to dissipate the heat.

Heretofore the automatic-feed header has been limited in regard to the variety of work that could be handled, and, in fact, is generally known by the term "rivet machine." With a view to increasing the adaptability of this type of header, consideration was given to features that would broaden its scope. One of the difficulties with the old type was that an inherent defect in the design of the shearing mechanism tended to distort badly the end of the sheared bar and make it difficult to center the next head. This condition has been corrected in the new design by building the feed mechanism at an angle to the machine proper. This gives an angle shear which, by compensating for the distortion, results in central heads, and makes it possible to upset and fill out an increased length of stock for large or special heads. The results obtained by this improvement will be understood by referring to the illustration Fig. 3, where a head produced on a machine of the old type is

shown at the left, while a head made on the new machine is illustrated at the right. A bending or straightening device is regularly supplied for large head work. This device is adjustable without stopping the machine, and gives complete control over the centering of stock or the flash.

In attempting to make bolts requiring a large amount of stock, any misalignment of the heading slide causes the stock to buckle and form a defective or unfilled head. It was to secure better alignment in the new design that suspended-type heading and gripping slides of unusual length were adopted. To obtain a long heading slide without the necessity of a long bed frame, the slide, which is 60 inches long, is extended up and over the crankshaft, as shown in Fig. 1. It has two separate bearings with the main shaft located between. Because of the long heading slide being provided with screw adjustments for side alignment and the heading tool being rigidly held in the bolster plate with only a small amount of overhang, large heads can be made with a minimum of buckling, and the range of the machine has been considerably increased. It is possible to make U. S. square heads, large-head carriage bolts, track bolts of various standards, valve tappets, rim bolts, and a variety of special work previously considered impossible on automatic-feed headers.

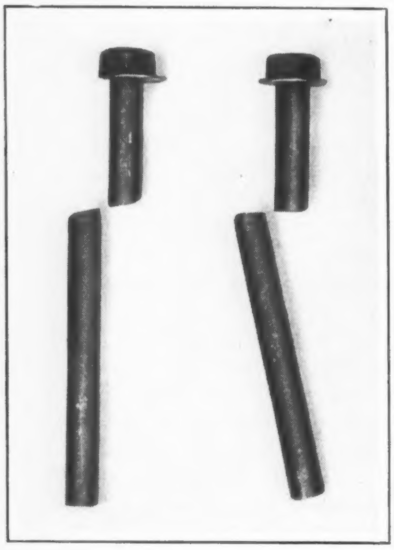


Fig. 3. Examples of Work produced with the Old and New Types of Shear

The machine is designed with a powerful shearing and gripping mechanism which enables work to be produced at low temperatures. This results in an improvement in the finish of the product, a material fuel saving, and a marked increase in die life. The claim is made that the life of the heading tools has been doubled, and that of the gripping dies, tripled. The machine has been designated as a "semi-hot" header, because rivets are made at a temperature of from 1000 to 1100 degrees F., and bolts at temperatures of from 1200 to 1500 degrees F. The work is made in one blow.

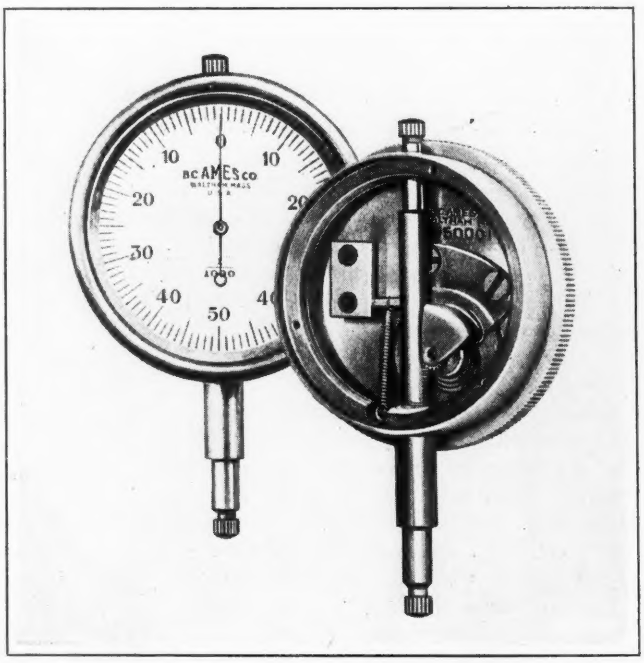
The stock gage is arranged with a screw of such pitch that a full turn of the handwheel gives a 1/8-inch adjustment of the stock. A wedge in back of the heading tool can be relieved to get the machine off center easily, and save delay when work is accidentally caught ahead of the dies. In the event of a "sticker" in the gripping dies, an automatic tripping device on the feeding rod automatically raises the rolls and stops the feed. The shear and faceplate construction and the horizontal adjustment of the heading tool bolster permits of adjusting the shearing travel. Water is supplied from the jacket in the faceplate to the back of the shear, but not to the cutting edge, there being provision to keep the water off the bar until it reaches the shear. A new type of attachment pushes rather than knocks the work from the dies, the work clearing itself from the dies by gravity. In the older machines, when the work was knocked from the dies, the blow would frequently drive it forward against the heading tool. The work would then be caught by the next advancing stroke of the heading tool which would take place before the blank dropped by gravity. The frame of the machine is only one-half the length of previous designs, and it is a steel casting. The distance from the center of the main shaft to the faceplate is 51 3/4 inches. The weight of the machine is approximately 31,500 pounds.

AMES DIAL GAGE

A dial gage designed to withstand gross abuse without losing its accuracy has been recently added to the line of products manufactured by the B. C. Ames Co., Waltham, Mass. This No. 55 gage may be dropped from a height of about five feet in such a way that the blow is applied to the plunger, it may be thrown about the room or hit with a hammer directly on the end of the plunger or spindle, or the case may become battered out of shape, and the gage will still function as it did before this harsh treatment. This is possible because the wheel staff is large and the spindle has a shoulder that comes in contact with the top of the case on the inside. The guide for the spindle is also of sturdy design, and has a stop to check the spindle.

Another feature of this new dial gage is that it has only thirty-nine parts against the fifty-five parts which make up the No. 5 gage. This simplicity has been obtained by putting both the rack and take-up wheels and the take-up spring on one staff, and using only one bridge to support these parts and the center pinion. A new bezel design eliminates other parts, such as lugs and lug screws, the bezel being held on the case by means of a brass wire spring. All parts are made in jigs and to standards, so that they may be easily replaced by similar members. All working parts are exposed to the eye by removing three screws and lifting off the back.

The guide block is a piece of solid brass of improved design with a slot at one side to allow for the passage of a stud on the spindle. A pin at the top of the block acts as a stop for the spindle after a travel of 0.3 inch. The bridge or support for the wheels is a piece of pressed brass, and is held to the gage plate by means of two dowel-pins and two screws. The case is of the same construction as that furnished with the No. 5 gage, being made of seamless brass tubing and machined all over. It is recessed at the back and front to receive the back and gage plates, respectively. The case stem is fitted to the bottom side of the case, and acts as a guide for the spindle; a hole drilled and reamed in the top side of the case also acts as a guide and bearing for the spindle. The bezel is made of brass, and knurled on



Ames Dial Gage in which the Number of Parts has been greatly reduced as compared with Previous Types

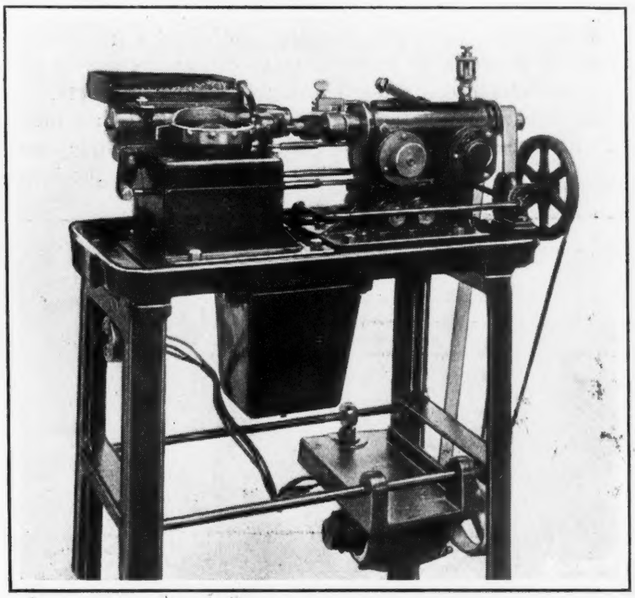
the outside. Both the case and the inside of the bezel are grooved to receive the small wire spring previously mentioned. This wire expands against both the case and the bezel, and yet travels smoothly around the groove in the case. The tension on the bezel can be changed by merely bending the wire to increase or decrease its pressure.

The wheel assembly is the special feature of the new gage, and patents covering its design have been applied for. The rack wheel consists of a large staff, a steel wheel, and a large brass wheel. The take-up wheel it fitted to a brass collar with a take-up spring, the collar being loosely mounted on the rack staff. Both the brass rack wheel and the take-up wheel engage the center pinion, but the rack wheel pushes the pinion while the take-up wheel drags against it, and thus eliminates backlash. Since two teeth are always in mesh with the pinion, the dial hand cannot be made to jump. The spindle is made of steel and is provided with rack teeth 1/8 inch wide and flat. The dial may be graduated to read from 0 to 50 each way, or from 0 to 25 each way; in other words, there may be either one hundred or fifty graduations.

KINGSBURY AUTOMATIC DRILLING MACHINE

An automatically operated machine intended for cross-drilling small work, such as binding posts and rivets, and also irregularly shaped objects, has been recently added to the line of automatic machinery built by the Kingsbury Mfg. Co., Keene, N. H. From the accompanying illustration, it will be seen that the equipment consists of the automatic sensitive drill head that was described in November, 1922, MACHINERY, and an automatic indexing fixture known as the No. 59. The work is simply laid in a dial provided with stations shaped to suit it, and is automatically clamped in the drilling position by means of spring pressure applied from the back.

The clamping jaw is mounted on a plunger, and is held in alignment by a hardened bushing which slides on a hardened and ground pin. The dial contains twelve stations and is indexed by means of a cam cut on the friction cam wheel which controls the feed of the drill. The machine stops at the completion of each cycle before indexing, unless the trip-lever is locked in its disengaged position to make the machine run continuously. The control is similar to that of a power press equipped with a dial feed. This feeding



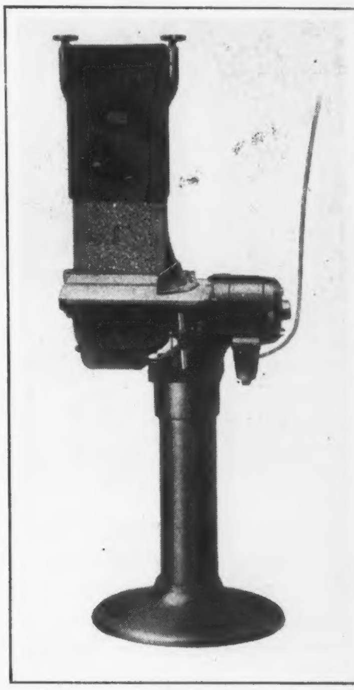
Kingsbury Drilling Equipment with Dial Feed

arrangement reduces the work-changing time to a fraction of a second.

Where the nature of the work will permit it, the pieces can be ejected readily from the dial at a point beyond the drilling position. Then it is an easy matter for the operator to keep the dial fed with sufficient rapidity to produce at the rate of thirty-five pieces per minute, using a spindle speed of 4000 revolutions per minute. However, only work requiring small holes can be drilled at this speed, brass parts being especially suitable. The drilling time is automatically adjusted to conditions, and so the operator does not need to bother with feed adjustments. The machine is equipped with a pump and a 1/4-horsepower motor.

SYRACUSE BELT-SANDER AND GRINDER

In the motor-driven belt-sander and grinder made by the Porter-Cable Machine Co., 1708-12 N. Salina St., Syracuse, N. Y., the grinding bed may be placed in any position from the horizontal to the vertical. This is a feature which makes the equipment convenient for handling different classes of work. The illustration shows this portable ball-bearing Type B-1 sander and grinder in the vertical position. It is intended for grinding and finishing parts made from metal, wood, and composite materials. A direct motor drive is furnished, the motor being fully enclosed. All moving parts of the equipment are mounted in ball bearings.



Portable Belt-sander and Grinder built by the Porter-Cable Machine Co.

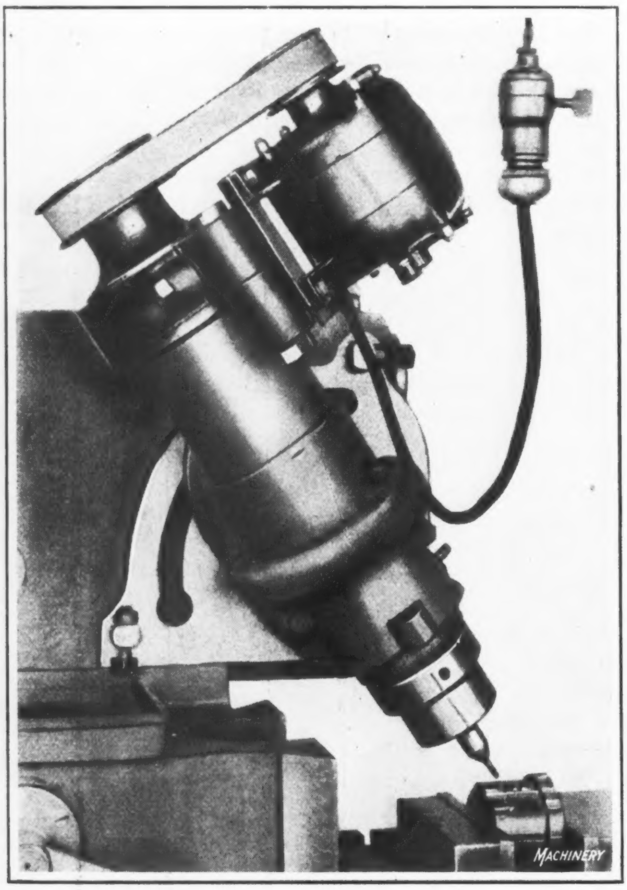
The table can be tilted by turning a handwheel, 45 degrees downward and 15 degrees upward. It is easily removable when it is desired to use the grinding bed in the horizontal position, and replaced by a rod which acts as a stop when grinding or sanding small pieces. Angle and core-print gages are used in a slot in the table, it being possible to set these gages at any angle, right or left, up to 45 degrees. The table measures 9 by 16 inches, and the top is located 36 inches above the floor. Adjusting screws insure parallel running of the belt, and they are used in securing the required tension and in changing belts. A leather belt can be used for buffing and polishing. All moving parts are amply protected by guards.

VAN NORMAN HIGH-SPEED MILLING ATTACHMENT

In milling such work as metal patterns, die-castings, and glass molding dies, it is often desirable to run end milling cutters of widely varying diameters at approximately equal peripheral speeds. For example, it may be desirable to run a 4-inch cutter at about 125 revolutions per minute, and a 1/4-inch cutter at about 2100 revolutions per minute. There are also many instances where it is preferable to combine heavy cuts with light and delicate ones during one set-up of the work.

It is for operations of the nature outlined that the Van Norman Machine Tool Co., 180 Wilbraham Ave., Springfield, Mass., has brought out a high-speed attachment to its duplex milling machine. This attachment has a separate ball-bearing spindle within the main cutter-spindle, which is driven by a high-speed ball-bearing motor that is adjustably mounted on the main cutter-head and moves with it. The motor is intended to be connected to an ordinary electric light socket.

The spindle is rigidly supported at the cutter end of the attachment in double ball bearings, there being provision for



Van Norman High-speed Milling Attachment

close end thrust adjustment. The rear or driving end of the spindle is supported in a floating ball bearing to compensate for endwise expansion or contraction. The front ball-bearing assembly is detachably mounted on the threaded nose of the main cutter-spindle, and the rear ball-bearing assembly is similarly mounted on the rear end of the main cutter-head. The motor assembly is attached on the rear ball-bearing housing, and is movable about the axis of the cutter-spindle. The motor is also pivotally mounted on an axis parallel to the spindle axis, a convenient means thus being provided for belt take-up. About five minutes is required to set up or take down this attachment. The high-speed spindle regularly furnished receives No. 5 B & S taper-snank end milling cutters.

The advantages claimed for this attachment are as follows: The cutter-spindle is radially movable on an axis, and can be set to cut at any angle from the vertical to the horizontal; the cutter-head is horizontally movable toward and away from the face of the column; and by the use of the attachment, it is possible to cut any irregular curves between a flat surface and a true circle by using a right-angle end-mill.

TURNER BLOW-TORCH

A blow-torch equipped with a safety valve is being placed on the market by the Turner Brass Works, Sycamore, Ill. The safety valve is located at the end of the horizontal pump cylinder, and is fitted with a diaphragm proportioned to give way automatically at an air pressure of 40 pounds per square inch. Thus the valve does not come into action until about double the normal pressure is present. A thumb-nut on the valve is turned by the operator to release the air pressure after his work is done, or to decrease the pressure during the operation of the torch. The pump is equipped with a leather which spreads out on the working stroke and closes on the return stroke.

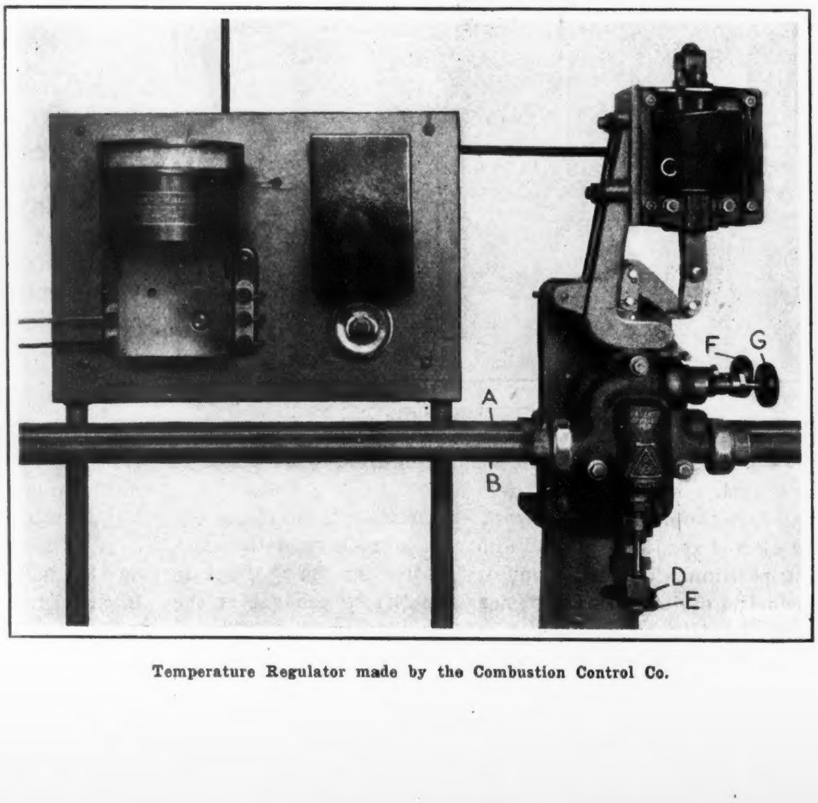
In its journey from the tank to the combustion chamber the fuel passes through the interior of a bronze baffle. This baffle is located near the outlet of the burner tube in the path of the flame and quickly becomes white hot. Its intense heat vaporizes the fuel into a hot, dry, highly inflammable gas, and because of this feature the torch can burn either kerosene or the leanest grade of gasoline for fuel.

TEMPERATURE AND PRESSURE REGULATOR

A new type of temperature and pressure control intended for use in connection with heat-treating furnaces and steam boilers is being placed on the market by the Combustion Control Co., Otis Bldg., Philadelphia, Pa. For temperature regulation, the equipment is supplied with a pyrometric controller, as illustrated, but for pressure regulation a different controller and a signal light are furnished. The control, as shown in the illustration, is arranged for burning fuel oil and using air or steam for atomization. The oil line is indicated at *A*, and the air or steam line at *B*. The control consists of two separate but duplicate bodies which are mounted on a common housing. Each body has independent by-pass and auxiliary regulating valves. The housing forms a base on which is mounted a frame for solenoid *C* and its connections.

The solenoid levers are connected to the top of a shaft extending through the housing, while the lower end of the shaft is connected to an adjustable cross-bar, which carries and operates in unison the auxiliary valves for regulating the fuel oil and the air or steam. This cross-bar is provided with handwheel *D* for adjustment, the handwheel having indicators and a vernier to insure accurate setting. The air or steam line is provided with an independent adjustment *E*. The by-pass valves *F* and *G* are also mounted on cross-bars and have a handwheel, indicator, and vernier adjustment. The steam-regulating valve is of the balanced type, and the oil-regulating valve is provided with special angular porting, that gives close regulation. The solenoid is wound for continuous service, and can be furnished for either alternating or direct current of any voltage or cycle The pyrometer controller has high and low contacts.

As an example of the operation, assume that in a furnace in which the temperature is regulated by pyrometric control the desired temperature is 1500 degrees F., then the by-pass



Temperature Regulator made by the Combustion Control Co.

valves are regulated to bring the temperature to about 1495 degrees F. and to maintain this temperature, and the indicator of the pyrometer is set to 1500 degrees F. After establishing radiation and vent losses, the current switch is closed, and as a temperature of 1500 degrees F. has been set by the indicator of the pyrometer, there will be a low contact and the circuit will be made through two coil relays and the energized solenoid. This will cause the core to rise with its lever and raise the shaft with the cross-bar and auxiliary valves, opening the valves and thus admitting more fuel oil and steam or air. As the cross-bar moves upward, an adjustment for fuel oil is made by means of the handwheel, and the amount of air or steam is regulated by the independent adjustment. This added fuel causes the temperature to rise until the pyrometer controller makes contact at 1500 degrees F. and opens the circuit. The solenoid is then de-energized and the auxiliary valves closed. Safety features provide against excessive temperature.

STARRETT STAINLESS STEEL RULE AND MILL GAGES

A rule which is made of stainless steel so that it will not rust or stain, and which is hardened and tempered is now being added to the line of tempered rules manufactured by the L. S. Starrett Co., Athol, Mass. This No. 1000 rule is made in 6- and 12-inch sizes, the former being 3/4 inch wide, and the latter 1 inch wide. Both sizes are graduated in eighths and sixteenths of an inch on one side, and in thirty-seconds and sixty-fourths of an inch on the opposite side.

The same concern has also brought out three new rolling mill gages designed for quick and accurate use on sheet and plate iron and steel. Two of these gages are for English or Birmingham standards, being for gage Nos. 000 to 25, and 1 to 32, respectively. The third gage is for U. S. standards Nos. 000 to 25. The decimal equivalent of each gage number is stamped on the back in extra large figures. The gages are hardened, tempered, and carefully tested. They are approximately 5 7/8 inches long, 1 7/16 inches wide, and 3/16 inch thick, and have a black finish.

SIMONDS WELDED HIGH-SPEED STEEL KNIVES

Woodworking machine knives which have a high-speed steel cutting edge welded, rather than brazed, to a backing of softer metal, are now being made by the Simonds Saw & Steel Co., Fitchburg, Mass., for use on planers, lathes, jointers, and other equipment. They are especially recommended for use on hard wood or where the knife must undergo exceptionally severe service. The line of the joint between the high-speed steel cutting edge and the backing piece is practically invisible. It is said that the edge does not separate from the backing when it is heated to a high temperature for the purpose of tempering. These knives are made in lengths up to 30 inches, widths up to 6 inches, and thicknesses up to 5/8 inch.

BROWN & SHARPE STAINLESS STEEL RULE

A 6-inch pocket rule made of stainless steel, which is known as the No. 350, is a recent addition to the line of mechanics' tools manufactured by the Brown & Sharpe Mfg. Co., Providence, R. I. This rule is rustproof, and will not stain or discolor. Every user appreciates the advantage of a rule that retains its bright finish so that it can be easily read, without the difficulty experienced in reading rules that have become rusty or blackened from use. The rule is graduated in eighths, sixteenths, thirty-seconds, and sixty-fourths of an inch.

NEW BOOK ON AUTOMOBILE SHOP PRACTICE

AUTOMOBILE SHOP PRACTICE. By Edward K. Hammond and Franklin D. Jones. 306 pages, 6 by 9 inches; 221 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $3.

The automotive industry undoubtedly leads all other machine-building industries in the development and use of tools and methods for reducing production costs. This treatise deals with the standard and special tools, machines, and processes employed in many of the most efficient automobile plants in the United States. The particular operations featured in the various chapters have been selected on account of their importance and because they represent approved practice.

Methods of manufacturing such essential parts as cylinders, pistons, connecting-rods, crankshafts, camshafts, crankcases, transmission gears, axles, steering knuckles, etc., are described and fully illustrated. Specific information is also given on the successive order of machining operations, rates of production, and other subjects of value to shop executives and students of efficient manufacturing practice. The purpose of this book is to cover the production of those parts that require unusual tools and processes for accuracy and high production rates.

In preparing this book, the operations and equipment in many different plants were studied carefully to obtain the best examples of practice. Methods of machining similar parts in different plants have been described whenever this was warranted by interesting variations either in the designs of tools and fixtures used, or in the general methods of procedure. While this treatise is confined to the manufacture of automobile parts, it should be valuable to every one interested in efficient machine-building practice, since most of the tools and methods are adaptable, in principle, to similar classes of work in other lines of manufacture. In fact, this book is an exceptionally valuable treatise on modern machine shop practice, as it features the manufacturing methods used in plants where machine parts are produced by the most efficient means available at the present time. It should also prove of value to those engaged in repair work on automobiles.

A comprehensive idea of the contents of the book can best be obtained by a list of the chapter headings: Boring and Reaming Automobile Cylinders; Finishing Cylinder Bores by Grinding; Machining Pistons and Piston-rings; Manufacture of Connecting-rods; Turning, Grinding, and Drilling Crankshafts; Machining Camshafts and Testing their Accuracy; Machining Transmission Gear Blanks; Operations on Gear-cases and Engine Bases; Axle Manufacture; Manufacture of Hanger Bolts, Steering Knuckles, and Yokes; Special Machines and Fixtures in Automobile Plants; and Conveyor Systems for Automobile Plants.

* * *

TENTH NATIONAL FOREIGN TRADE CONVENTION

At the tenth national foreign trade convention, which will be held in New Orleans, May 2 to 4, a program covering a number of different phases of the foreign trade situation will be offered. The general convention theme will be "European Conditions as Relating to World Trade." Papers and discussions will deal with such subjects as "European Progress During the Last Year"; "Trade Barriers"; "Trading in the Face of Depressed Exchange"; "Education for Foreign Trade"; "Banking Facilities for Foreign Trade"; "Problems of the Export Manager"; "Foreign Trade Facilities of the Federal Reserve System"; "Trade with Latin-America"; "Inland Water Transportation, as Affecting Farms and Railways"; "Railway Service for Foreign Trade"; "The Shipping Situation of the World"; "Foreign Credits"; and "Export Advertising."

THE MACHINE TOOL SITUATION IN FRANCE

From MACHINERY'S Special Correspondent

The Wiesbaden agreement, about which much has been written, never became of great importance. Most of the German machine tool builders did not favor it, because when they delivered machines under this agreement they were paid in marks by the German Government. They preferred to sell directly to French buyers and to receive payment in francs or dollars. The prices of German builders at this time are practically all in dollars or francs for foreign trade. Furthermore, since January 13, the Wiesbaden agreement has not been in force, and Germany is no longer able to export machine tools to France at a reduced tariff. The total value of German machine tools imported under the Wiesbaden agreement was about 10,000,000 francs.

Since 1919 German machine tools have not entered France to a value of over 20,000,000 francs, of which one-half was for the devastated area, under the Wiesbaden agreement, as mentioned. This is a volume which is quite negligible, when compared with second-hand machine tools valued at 200,000,000 francs available for sale in France. The following prices of German machine tools made by a first-class concern may be of interest. These prices are for stocks on hand in Paris with custom duties and freight paid.

	Francs
Boring mill, 34-inch table, weighing 7200 pounds	22,300
Slotter, with ram travel of 14 inches weighing 15,000 pounds	25,840
Tool-grinding machine, weighing 1900 pounds	7,350
Horizontal milling and boring machine, diameter of spindle 6 inches, weighing 57,000 pounds	67,900

In order to cope with the danger of German imports, the French builders of machine tools have joined in an association known as Union Metallurgique, the object of which is to sell to the manufacturers in the devastated areas on credit terms similar to those offered by German builders. Generally speaking, therefore, it is not German competition that prevents American firms from selling machine tools in France.

With the present state of the market, and as long as the exchange does not return to about seven francs to a dollar, it will be impossible to sell ordinary American machine tools in France, but it is quite practicable to sell such American machines as are not built in France, and there are several types of such machines now being sold; but French builders are constantly developing facilities for building the usual types of machine tools, such as engine lathes, drilling machines, and hacksaws. The industrial crisis through which France has passed is gradually passing. In the machine tool trade, particularly, old stocks are diminishing and new machines are being sold.

* * *

MEETING OF ELECTRIC STEEL FOUNDERS' RESEARCH GROUP

The Electric Steel Founders' Research Group met in Detroit, Mich., February 5 and 6. Important reports relating to electric furnace practice, core practice, and facing practice were discussed. It was decided to expand the scope of the work of the Research Group, by providing for greater activity on the part of the committee on new uses for steel castings. For this purpose, W. J. Corbett was engaged as industrial engineer, to be associated with R. A. Bull, research director. Mr. Corbett has had several years of experience in various steel foundries. His headquarters will be at the central office of the Electric Steel Founders' Research Group, 639 Diversey Parkway, Chicago, Ill. The Research Group is composed of the following firms: The Electric Steel Co., Fort Pitt Steel Casting Co., Lebanon Steel Foundry, Michigan Steel Casting Co., and Sivyer Steel Casting Co.

TONNAGE REQUIRED TO STRAIGHTEN COLD-ROLLED STEEL

By GEORGE N. DORR

The accompanying table gives the pressures required to bend cold-rolled steel of various diameters and lengths on different length centers. The values given were obtained by tests made in actual shop practice. It will be found that the calculation of the pressures necessary to bend cold-rolled steel of the sizes specified will give values that are somewhat lower than those given in the table. This is due to the fact that the width of the bearings on which the shaft rests and the width of the ram face are not taken into consideration in the calculations. In other words, the bending ram is considered as a knife edge, whereas in actual practice a ram having a flat face of some width must be used. If the table is used for material of a different tensile strength from that of cold-rolled steel, it is necessary to multiply the values given by a fraction obtained by dividing the tensile strength of the material to be bent by the tensile strength of the cold-rolled steel, which is taken as 60,000 pounds per square inch.

PRESSURES FOR STRAIGHTENING COLD-ROLLED STEEL

Diameter of Shaft, Inches	Distance between Shaft Supports, Ins.	Pressure Required, Tons	Diameter of Shaft, Inches	Distance between Shaft Supports, Ins.	Pressure Required, Tons	Diameter of Shaft, Inches	Distance between Shaft Supports, Ins.	Pressure Required, Tons
1½	6	10	2½	19	15	3½	25½	30
1½	5	15	2½	14	20	3½	22	35
1½	4	20	2½	9½	30	4	32	35
1½	3	30	2½	8½	35	4	22	50
1½	2	35	3	48	10	4	18	65
2	18	10	3	32	15	4	10	125
2	12	15	3	24	20	4½	31	75
2	9	20	3	16	30	5	45	50
2	6	30	3	14	35	5	35	65
2	5	35	3	10	50	5	20	125
2	4½	50	3	8	65	6	36	125
2	4	65	3	5	125	......	.....	.....
2½	29	10	3½	48	20	......	.....	.....

Machinery

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AN AUTOMOBILE ENGINE IS NOT A MOTOR

The Society of Automobile Engineers takes exception to the use of the word "motor" to designate the power plant of an automobile, truck, airplane, tractor, or other automotive appliance. Motor is the correct name for an electrical machine used for changing electrical into mechanical energy. An electric motor is commonly used on gasoline automobiles in connection with the starting apparatus, but the use of the word "motor," as applied to internal combustion engines, can be correctly understood only by the context. The continued misuse of the word should be discouraged. We say "electric motor" and not "electric engine," and we say "steam engine" and not "steam motor," and so, the logical name for an internal combustion unit is "engine" and not "motor."

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A. S. M. E. SAFETY CONFERENCE

A conference was held Saturday, February 17, at the American Society of Mechanical Engineers, 29 W. 39th St., New York City, with a view to discussing whether a national safety code for the forging industry ought to be adopted, and also whether a similar code should be adopted for the plate and sheet-metal working industries. The conference was called at the request of the Safety Code Correlating Committee which has had this subject under consideration for some time. A thoroughly representative group of men from all the interested industrial bodies were invited to attend.

PERSONALS

L. K. Berry, for sixteen years with the Warner & Swasey Co., Cleveland, Ohio, has resigned his position of domestic sales manager to become manager of sales for the Detroit Twist Drill Co., Detroit, Mich.

A. W. Berresford has resigned as vice-president and director of the Cutler-Hammer Mfg. Co., Milwaukee, Wis. Arrangements have been made whereby his services will be available in specific matters.

E. S. Lammers has recently returned to the employ of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., with whom he was associated from 1913 to 1919, and will be in charge of the controller sales in the industrial department.

Howard W. Dunbar has been made assistant to William La Coste Neilson, general sales manager and vice-president of the Norton Co., Worcester, Mass. Mr. Dunbar has in the past been sales manager of the Norton Co.'s grinding machine division.

Edwin L. Andrew has been appointed assistant to the manager of the department of publicity of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Mr. Andrew has had both engineering and advertising training and experience.

A. W. Copeland, president of the Detroit Gear & Machine Co., Detroit, Mich., at a recent meeting of the executive committee of the American Gear Manufacturers' Association was elected to fill the vacancy on the committee caused by the death of John B. Foote.

Alfred J. Doughty, formerly factory manager of the Burroughs Adding Machine Co., was elected director and vice-president of the company at the annual stockholders' meeting recently held in Detroit. He will have charge of all factory and mechanical operations of the company.

W. E. Sykes, of the Power Plant Co., West Drayton, England, has disposed of his Canadian and United States patents relating to gear-cutting machinery, to the Farrel Foundry & Machine Co., Ansonia, Conn., and Buffalo, N. Y., and is at present located at the Buffalo plant, where he expects to remain for some time.

William Blake Patterson, president of the Patterson Tool & Supply Co. of Dayton, Ohio, recently returned from his European tour and is again actively engaged in the business of the company. Mr. Patterson reports business as gradually improving, although the absorption of war material interferes somewhat with the sale of new tools.

Cloyd M. Chapman has become affiliated with Dwight P. Robinson & Co., Inc., New York City, as consulting materials engineer. Mr. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, will in the future represent Dwight P. Robinson & Co. in the committee work of these societies.

W. W. Reddie has been appointed assistant to the manager of the industrial department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. He will have charge of the railroad shop, metal-working, machinery manufacturers', and material-handling machinery sections of the department. Mr. Reddie has been associated with the Westinghouse company ever since he graduated from college, with the exception of the period during which he served in the war, and was previously manager of the metal-working and railroad shop sections.

Clyde M. Carr has retired as president of Joseph T. Ryerson & Son, Inc., Chicago, Ill. Mr. Carr has been unable to take an active part in the management of the firm for the last two years on account of poor health. He will continue, however, as a director, but will be succeeded by Joseph T. Ryerson, as president. Mr. Carr was born in Illinois in 1869, and first became associated with Joseph T. Ryerson & Son in 1890. He has taken a very active part in the management of the firm, and in 1911 was elected president. In addition to his connection with the Ryerson concern, he is a director of the Corn Exchange National Bank, trustee of the Art Institute of Chicago, a member of the Chicago Plan Commission, and a member of the American Iron and Steel Institute.

Joseph T. Ryerson was elected president of Joseph T. Ryerson & Son, Inc., Chicago, Ill., at the regular annual meeting of the board of directors. Mr. Ryerson was born in Chicago in 1880, and is the grandson of the Joseph T. Ryerson who founded the firm. Immediately after graduating from Yale in 1901, he went to work for the American Sheet Steel Co., now the American Sheet & Tin Plate Co., at the company's mill in Vandergrift, Pa. In October 1902, he started with Joseph T. Ryerson & Son in Chicago and in 1904 was elected treasurer, becoming vice-president in 1911. Mr. Ryerson is also actively interested in the work of the National Chamber of Commerce, a director of the People's Trust and Savings Bank of Chicago and of the Morris Plan Bank of Chicago. He is also a member of the American Iron and Steel Institute.

M. Kessler, formerly superintendent of the Athol Machine & Foundry Co., Athol, Mass., has been appointed general manager to succeed H. R. Linton, who has left the company. Mr. Kessler has had an extensive machine shop experience. Previous to 1914, he was general foreman of the machine shop of A. E. Meyers Co., Pittsburg, Pa., and when this company was purchased by the Standard Steel Car Co. in 1915, he remained with the new company as superintendent. In the latter part of 1915, he went to the Westinghouse Electric & Mfg. Co. as general foreman of the department producing 8-inch British shells; later, he was in charge of the production of parts for the Browning machine gun at Springfield, Mass. In 1919 he became general superintendent of the Athol Machine & Foundry Co., of which he has now become general manager.

M. F. Cunningham, formerly of the Superior Corundum Wheel Co., is now associated with the Waltham Grinding Wheel Co. of Waltham, Mass. Mr. Cunningham began work for the Waltham Grinding Wheel Co. about thirty-two years ago, and remained in the employ of that company for about fifteen years. He then left to found the Superior Corundum Wheel Co., which he started in a very small way with only a couple of men. It was undoubtedly through his personal efforts that this concern was built up to its present size. Three years ago he sold out his interests in the Superior Corundum Wheel Co. to the International Abrasive Co., and since that time he has been acting as manager, on behalf of the consolidated companies, for the Superior Corundum Wheel Co. Now he has entirely severed his connection with that company, and again associated himself with the Waltham Grinding Wheel Co.

Henry A. Klein, who designed and prepared for production the latest model for the Durant Motors Co., is now associated with the Eadie Trailer Corporation, 191 Ninth Ave., New York City, in charge of standardization of design and production of this company's patented devices for trailers and other four-wheeled reversible tracking vehicles. The Eadie Trailer Corporation proposes to standardize this line, and as a parts manufacturer, supply its devices to manufacturers of reversible four-wheeled trailers, industrial trucks, etc., under license to use its models and devices. The Eadie Trailer Corporation was recently formed to take over the business of the Eadie Vehicle Gear Co., and among its officers and directors are Theodore D. Pratt, general manager of the Motor Truck Association of America, and A. L. Campbell, formerly chief engineer of Brewster & Co. John M. Eadie is president of the corporation.

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TRADE NOTES

International Sales Co., 832 Hearst Bldg., San Francisco, Cal., has been organized to promote the export sales of American products. The company will open a central foreign sales office in Shanghai, China, from where its foreign sales activities will be directed.

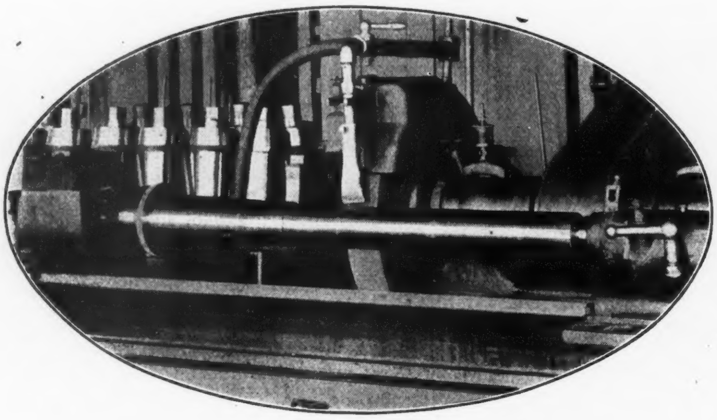
Solomon-Abbott Co., industrial engineers, 175 Fifth Ave., New York City, have changed their name to Abbott, Merkt & Co., Inc. There will be no change in the personnel of the present organization, except that G. R. Solomon will be active only as a director and stockholder.

Leiman Bros., manufacturers of air pumps for automatic feeders, folders, labelers, banders, and other automatic machines, have found it necessary, owing to the rapid increase in their business, to remove their New York office and show room to larger quarters at 60-62 Lispenard St.

Oilgear Co., 60 Twenty-seventh St., Milwaukee, Wis., manufacturer of variable-speed hydraulic power transmissions, has opened an office in Detroit, at 415 E. Jefferson Ave. Donald Clute, who formerly handled the sale of Oilgear products for the Cadillac Machinery Co., has been placed in charge of this office.

Doehler Die-Casting Co., Court, Ninth, and Huntington Sts., Brooklyn, N. Y., elected the following directors for the ensuing year at a recent meeting of the stockholders: H. H. Doehler, Charles Pack, John A. Schultz, Jr., H. B. Griffin, John Kralund, F. L. Duerk, John L. Pratt, A. P. Sloan, Jr., and E. J. Quintal.

American Electric Fusion Corporation has purchased a site for its new factory on Diversey Blvd., Chicago, Ill.



Two essentials for good work —High-grade Machines and

The quality of work a machine produces depends on the quality of the machine itself—particularly true of a grinding machine. To grind work to close limits with a smooth, even finish requires a machine correct in every detail of design and manufacture.

The combined skill of experienced engineers and expert workmen gives Brown & Sharpe Grinding Machines the qualities essential for producing good work. Manufacturers seeking a satisfactory solution of their grinding problems should consider the advantages of

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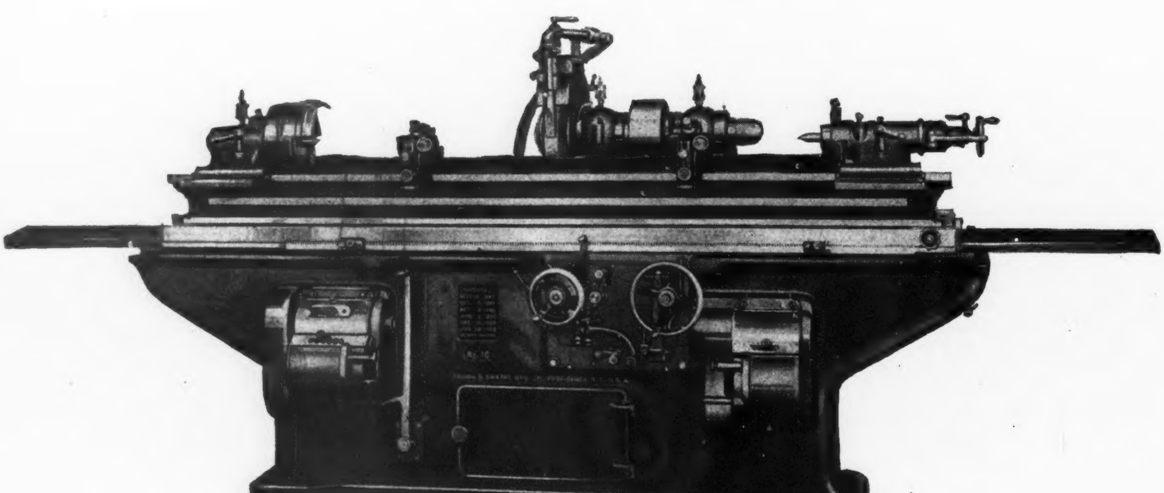

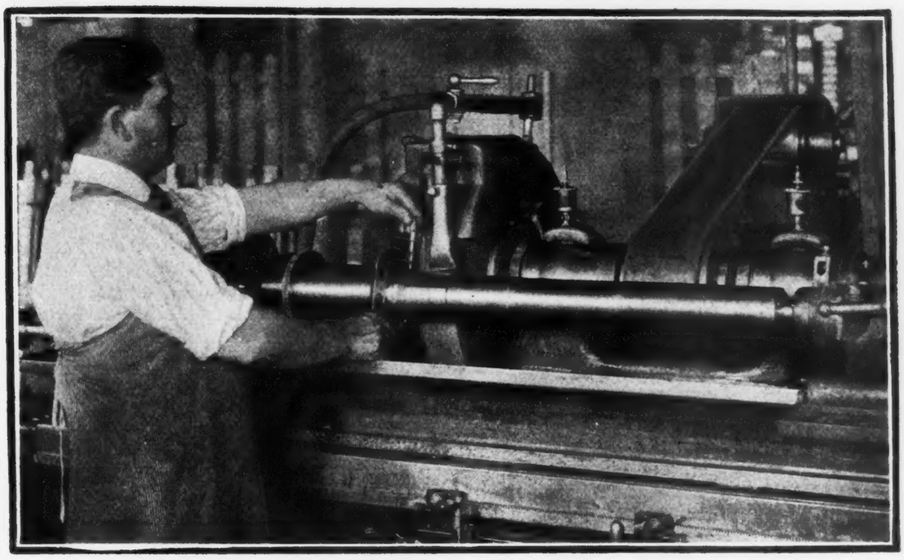

Reliable Machinists' Tools

Without reliable tools the mechanic working to close limits is at a serious disadvantage. The quality of his work and the speed of his production are largely influenced by the confidence he has in the tools he uses. Brown & Sharpe Tools are dependable and give men the confidence essential for good work. Every mechanic will be interested in

the new line of REX MICROMETERS

Rex—a complete line of Brown & Sharpe Micrometers in 24 sizes covering a range from 0 to 24 in. Sturdy frame of I-section combines lightness with strength. The rectangular shape of the frame gives greater measuring capacity than a frame of the circular type. Every Rex Micrometer is regularly furnished with a Clamp Ring which locks the spindle and preserves the setting.

Write for Rex Circular

Look up Rex Set No. 135 shown in this circular. This set of six micrometer calipers measuring from 0 to 6" will prove useful for the average work found in Grinding Rooms.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

Rex Micrometers are Brown & Sharpe Tools

A program of expansion that will be carried through in 1923 includes plans for a total floor space of 80,000 to 100,000 square feet. The first unit, a two-story building of 20,000 square feet, is being erected now.

HARRISBURG MFG. & BOILER CO., Harrisburg, Pa., recently opened a sales office in the Park Row Building, New York City. The company manufactures boilers, tanks, steel stacks, breechings, and special steel plate and structural steel. It also makes a specialty of contracting to build entire lines of machinery for companies not having their own shops.

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago, Ill., manufacturer and distributor of Hanna riveting machines, air hoists, sand sifters, Mumford molding machines, and the Milwaukee sprue cutter, is now represented in Detroit and surrounding territory by the Charron Engineering Sales Co., 1002 Real Estate Exchange Bldg., Detroit, Mich.

SUPERIOR SPRING CO., Springfield, Ohio, manufacturer of Superior coiled wire springs, has found it necessary, owing to the increasing demand for its product, to double its previous capacity. The company reports that its 1922 business was more than double that of 1921, and the indications are that the demand in 1923 will require this increase in manufacturing facilities.

HARRY E. HARRIS, Bridgeport, Conn., engineer specializing on manufacturing methods, has taken over the activities of Hubbard, Harris & Rowell, Inc., and will personally direct all the work of organization, installations, equipment designs, and economic investigations. The business will be carried on in the future under the name of Harry E. Harris, consulting engineer.

BLAKELY MFG. CO., Fullerton Ave. and Monnier Road, Detroit, Mich., manufacturer of automobile shipping fastenings, has moved into a new modern factory, containing about 12,000 square feet of floor area. The company is equipping for increased production in its regular lines, and is also preparing to develop some new lines of shipping fastenings for the general manufacturing trades.

REED-PRENTICE CO., announces that its New York office, Room 536, Singer Bldg., 149 Broadway, is acting as selling agent for the bench lathes and internal grinding machines manufactured by the Rivett Lathe & Grinder Co., Brighton District, Boston, Mass. The office is in charge of P. K. Dayton. The Rivett Lathe & Grinder Co. has had a similar arrangement with the Reed-Prentice Co. in the Detroit territory.

EDWARD HOLLANDER TOOL CO., 142 Miller St., Newark, N. J., has changed its name to HOLLANDER-WESTMAN TOOL CO., and has moved to larger quarters at 566 Forest St., Arlington, N. J. E. Hollander is president, and J. Westman is secretary-treasurer. The concern will market the line of improved Hollander adjustable broaches and a department will be maintained for the manufacture of tools, jigs, dies, and special machinery.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburg, Pa., is erecting a $700,000 building in Chicago, located at West Pershing Road and Leavitt St. This building will be used for a combination district sales office, warehouse, and service shop, and is the first of three buildings to be erected by the company at this location in Chicago. It will be seven stories high, of reinforced concrete construction, and will have 218,000 square feet of floor space.

AMERICAN ENGINEERING CO., Philadelphia, Pa., manufacturer of Taylor stokers and marine auxiliaries, has taken over the STANDARD CRANE & HOIST CO. and the patent and manufacturing rights to the mono-rail electric hoist formerly known as the "Standard." H. S. Valentine, chief engineer of the Standard Crane & Hoist Co., will remain with the American Engineering Co., directing the sales and supervising the manufacture of the hoists.

MIEHLE PRINTING PRESS & MFG. CO. is erecting additions to its plant at 14th and Robey Sts., Chicago, Ill. Three new buildings will be erected and connected by a bridge with the present plant. One building will be used for machine shop, storage, packing, and shipping, assembling, erecting, and testing, and will also contain office, drafting-room and experimental department. A pattern shop and storage building and a blacksmith shop will also be erected.

KELLER MECHANICAL ENGINEERING CORPORATION, 74 Washington St., Brooklyn, N. Y., has succeeded the KELLER MECHANICAL ENGRAVING CO., the management remaining the same. The change in the name was made because the word "Engraving" did not accurately describe the business of the company, and the new name was adopted as better fitting the activities of the corporation, which builds die-sinking and mold-cutting machines, and also produces dies and molds.

FARREL FOUNDRY & MACHINE CO. of Ansonia, Conn., and Buffalo, N. Y., has purchased the Sykes patents covering the United States and Canada, for the manufacture of double helical or herringbone gear cutting machines. This company will manufacture both gears and machines for the trade at its Buffalo plant where it now has a complete line of machines in operation ranging from the smallest to 15 feet in diameter. W. E. Sykes, of West Drayton, England, is at present with the Farrel Foundry & Machine Co. at the Buffalo plant.

PAR-CON CO., LTD., Bourse Bldg., Philadelphia, Pa., is a partnership formed by Earl Parent, formerly mechanical engineer for the Miller Lock Co.; William A. Parent, formerly general manager for the Dexter Metal Mfg. Co.; and Walter M. Conard, formerly secretary and purchasing agent for the Miller Lock Co. The new company will operate as material engineers for the mechanical development and sale of metal products, including finished and raw material of cast, sheet, bar, and wire products, as well as metal lockers, shelving, and office equipment.

ASSOCIATED SPRING CORPORATION, New York City, has been incorporated under the laws of the state of New York. The incorporation embraces the following concerns: Wallace Barnes Co., Bristol, Conn.; William D. Gibson Co., Chicago, Ill.; Raymond Mfg. Co., Corry, Pa.; Barnes-Gibson-Raymond, Inc., Detroit, Mich., and the Wallace Barnes Co., Ltd., Hamilton, Ont., Canada. These concerns have all been in the business of spring manufacturing for many years. The new arrangement contemplates no change in either the management or the personnel of any of the organizations involved Each business will operate as heretofore.

STANDARD CONVEYOR CO., North St. Paul, Minn., has acquired, by purchase, the rights and patents pertaining to the Brown line of portable and sectional piling, lifting, conveying, loading, and unloading machinery, for the handling of packed and loose material. This line of machinery has been manufactured by the BROWN PORTABLE CONVEYING MACHINERY CO. at North Chicago for ten years. The present plant will be continued in operation by the Standard Conveyor Co., and correspondence relating to this line should be addressed to the Standard Conveyor Co., Brown Portable Products Plant, North Chicago, Ill. The old organization will also be continued.

HUNTER CRUCIBLE STEEL CO., 6600 Grant Ave., Cleveland, Ohio, has acquired the plant and property formerly owned by the ELECTRIC STEEL & FORGE CO., Cleveland, Ohio. The new company will produce a full line of hot-rolled high-speed, carbon, and alloy tool steels, as well as automotive and special analysis steels. The annual tonnage capacity of the present facilities of the plant are 6000 tons of hot-rolled bars, and 12,000 tons of high-grade forgings. The officers of the company are Arthur H. Hunter, president; Frank B. Lounsberry, first vice-president; Donald W. Wells, second vice-president; A. B. Smythe, treasurer; L. H. Vinnedge, secretary; and F. J. Beebe, assistant secretary.

RAINEY TOOL CO., Cleveland, Ohio, have acquired the selling rights for the entire output of the factory of the RAINEY BROS. TOOL CO., Grove City, Pa. A. J. Bolger, formerly district manager for the Mid-West Mfg. Co., of Minneapolis, Minn., and D. C. Paul, formerly Cleveland branch manager for the Black & Decker Mfg. Co., are officers of the Rainey Tool Co., with headquarters in the Plymouth Bldg., Cleveland, Ohio. This company is manufacturing a complete line of tools for steam and pneumatic hammers, and miscellaneous hand tools for machinists, plumbers, and contractors. The factory will remain in Grove City, Pa., where additional ground has been obtained and a large building is being erected.

GALLMEYER & LIVINGSTON CO., 14 Campau Ave., N. W., Grand Rapids, Mich., has been incorporated with a capitalization of $450,000. In this company are consolidated the Valley City Machine Works, the Grand Rapids Grinding Machine Co., and the Union Machine Co. A new factory will be constructed immediately to house the consolidated organization. Practically all the products of the three original companies will be continued, which include twist drill grinders, tap grinders, universal cutter grinders, plain grinding machines, disk grinders, wet tool grinders, milling machines, single-, double- and multiple-spindle boring woodworking machines, universal saw benches, band saws, jointers, plain saw benches, and wood shapers. Christian Gallmeyer will be president of the new corporation; S. Owen Livingston, vice-president; William H. Gallmeyer, second vice-president; B. C. Saunders, secretary; and Charles H. Gallmeyer, treasurer. J. DeKoning will be executive superintendent. These officers, with Robert D. Graham, will constitute the board of directors.